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Employers' Liability, and Insurance Against It.

For some time past we have been publishing almost every week, under the heading "Legal Notes," abstracts of recent cases which have arisen in the mechanical trades. Most of them have had reference to the liability of employers to their workmen for injuries sustained in the employment. The rules of law in this connection are easily learned, but an understanding of their application can only be approximated. Proprietors and superintendents of shops in which machinery is used can profitably study these various cases that arise in order to attain to a closer perception of their legal duties to their own employees. The general rule is that an employer is not responsible for injury to his employee unless it occurs through negligence chargeable to him. He does not guarantee his employee immunity from accident due to defective machinery or to an unsafe place to work in or to careless and incompetent fellow servants. He does, however, incur liability if any of these things, which causes the injury, has been allowed to exist through his own negligence, or through the negligence of anyone to whom he had delegated authority. This, in brief, is the common law upon the subject, but it may be modified by statute, as it sometimes is, and at the discretion of a legislature the responsibility of an employer can be made more nearly absolute.

Since employers can never feel sure that they are out of reach of a jury's verdict of negligence on the part of those who represent them, or even on their own part, and especially in a jurisdiction where their accountability has been widened, it is natural that systems have sprung up for taking out policies of insurance against this, as against other risks. The first of the legal notes printed in this week's paper is upon a case in which the matter of liability insurance came up. It was a case where a boy of thirteen years had, without suitable instruction or warning, been set to work upon a dangerous machine and, naturally enough, lost four of his fingers in consequence—establishing a clear enough cause of action for negligence. But the plaintiff's counsel, hoping to render the jury less reluctant to bring in a fat bill of damages, made the gratuitous remark that it would not have to be paid by the boy's employer, since he was insured. The lawyer was sharply reproved by the court, who instructed the jury to pay no attention to the statement, and if the defendant had requested it at the time he would have been entitled to a ruling of mistrial.

This case is interesting as showing one way in which the fact that an employer's liability is insured against might work injustice; but as the insurance company would there have been the loser, no one's sympathies are likely to be very deeply stirred. It is quite as apt, however, to be the persons employed to whom the arrangement is detrimental. In a recent number of "The Independent," Edward Tregear, New Zealand Commissioner of Labor, shows the state of affairs existing in that country. For several years there have been in force acts intended to fix liability upon employers for injury to workmen arising from the employer's negligence or from defects in the plant, machinery, etc. These seemed to work pretty well for a time, but presently an accident insurance company was formed in the colony by unscrupulous men. The agents of this went everywhere and persuaded not only manufacturers and contractors, but farmers and pastoralists, whether ignorant or interested in evading the law, to join in the scheme. As a result complaints arose everywhere that deductions were being made from the wages of workmen to pay premiums upon the accident insurance, in many cases without their consent. The proportion deducted was about 3 per cent., but this was strongly begrudged where the wages were small. It was asserted that the employer paid half of the premium, but he held the policy, and it is believed that in many cases his subscription was bogus. The worst feature of it was that the employer was relieved from the incentive to provide safe appliances and the workman was compelled to pay a premium in order to get himself killed or maimed.

A legislative remedy, based rather upon the workman's right to his full wages than upon the moral question of the employer's carelessness as above indicated, was proposed, and after initial defeat in the Upper House, it became a law. Further reform measures are likely to be adopted at the session of the Colonial Parliament about to open. The ministry expects to introduce a bill suggested by recent legislation in Great Britain, which will widen the scope of the liability of employers for injuries to their workmen, and in effect make them accountable for all accidents. It is considered that these are among the risks of industry which it is just that the employer should assume. They will ultimately be compensated for in prices and paid for by the general public as trade adjusts itself to the new condition. In the meantime, however, the employers must sustain the loss, and Mr. Tregear argues that the solution is to be found in mutual insurance on their part. In Austria the employers in a particular district, whatever the trade, form an insuring league. In Germany each trade, irrespective of geographical arrangement, has its association. The German system is probably preferable because the manufacturers in the same line of business are better qualified to keep a sharp lookout on each other. The league employs inspectors, whose rules are more stringent and whose attention more frequent than those of the Gov-

ernment, and who suffer no rotten boilers or dangerous machinery to exist undenounced. The annual expense of the insurance to the employers, usually in the form of premiums, amounts in the perilous trades to about 2½ per cent. Such a plan as this is advocated for New Zealand.

There may be some question what is the best possible system in regard to employers' liability and insurance that could be devised, but there is no question whatever that the one mentioned by Mr. Tregear, where the men were paying the cost of their employers' carelessness is one of the worst. The danger is one involved in all insurance of this nature where stringent precautions are not taken. Almost any arrangement by which a man can avoid responsibility from his own negligence is to be deprecated. It has been a much disputed point in the courts whether a transportation company can by express contract relieve itself of accountability to its patrons for the results of its own carelessness. However hopelessly the judges may be disagreed, we think ordinary men will be found of pretty much one opinion on this point when human life or limb is the risk at stake. The principle involved in employers' liability insurance seems to us to be very nearly the same, and the case should be regarded in the same way. It may be contended that fire insurance likewise is a provision against the negligence of the insurer, but that argument is far from perfect. In fire insurance the negligence of the owner of the property is but one cause among many important ones which may occasion the loss. It is but an incident to the total of possible causes, and numerous iron-bound clauses of the policy go far toward eliminating it. In employers' liability insurance, however, the policy-holder's own negligence (where the matter has not been regulated by statute), in person or through his representative, is about the only ground of his liability, and hence is the principal source of risk against which he insures. Under the German system of rigid inspection by the mutual insurance leagues the chance for carelessness is reduced and the aspect of the matter is altered. Any private insurance company which maintains an equally rigid system of inspection is entitled to the same qualification in its favor. But if the insurance plan is applied without such a safeguard it seems to us little short of criminal.

A hot-weather suggestion comes in from a subscriber, who has taken an ordinary upright drill press and attached to the upper end of the spindle two fan blades made of wood, so that as the spindle revolves, it forces a current of air downward upon the operator. The suggestion comes from a country where they are supposed to have considerable very hot weather, and we suspect that this invention has been born of necessity. A beautiful point about it that might escape the observation of the superficial is the fact that as the hole being drilled grows deeper and the operator therefore becomes more and more completely exhausted, the fan approaches closer and closer, so that the current of air increases in strength. Seriously, however, we should judge that in many a hot corner where drill presses are located, these fan blades might result in more work being done, and they certainly would remove the temptation to get away occasionally for a breath of fresh air.

We have received a pamphlet from A. Lincoln Hyde, of Cincinnati, O., which describes "a decimal system of weights and measures for the English-speaking people," which Mr. Hyde has devised and which has the inch as its basis. He gives various names to the decimal multiples of an inch, of the square inch and of the cubic inch; but it is, after all, very similar to the metric system, except that it has the inch, or in reality the yard, instead of the meter as its basis. To adopt it would involve, it seems to us, almost as much bother and confusion as it would to adopt the metric system, and after we adopted it we would still not be in accord with the other nations of the earth that are using the metric system; so that we can see no practical utility in Mr. Hyde's proposition.

Germany has given up the Reaumur thermometer, and after January 1, 1901, will use only the Centigrade. This would be a good time for us to brace up and make a change. The Reaumur is not as bad as the Fahrenheit scale, which begins nowhere and ends nowhere. The Reaumur starts with 0° at the freezing point, but at the boiling point it is only 80° instead of the 100° of the Centigrade scale. It would cost little and entail little inconvenience for us to adopt the centigrade scale, and it is a most unaccountable thing that it is not done. The problem of the change is in no respect comparable with that involved in the adoption of the metrical system.

A recent boiler explosion is reported in the Philadelphia "Ledger," and the following is offered in explanation of the cause of the occurrence: "The engineer discovered a pile of lumber near the boiler to be on fire, and at once turned the hose on it. Some of the water falling on the boiler caused an explosion, which wrecked the entire plant and fatally injured three men." Don't believe it. Boilers are not exploded in that way. Probably the engineer got so excited about the fire that he forgot to properly attend to the boiler.

The British torpedo boat "Viper," driven by the Parsons turbine, on a recent trial made forty-three miles an hour. The many apparent advantages of the turbine system, it giving, as is claimed, double the power for a given space, with a saving of one-third in weight, the absence of vibration and the cleanliness and comfort of the engine room, would seem to promise its extensive adoption for larger vessels, if it can be demonstrated, as has not yet been done, that the engines and propellers can be run continuously for sufficient lengths of time.

Technical Publications.

"The Textile World's 1900 Official Directory of the Textile Mills and of Buyers of Textile Fabrics." Boston, Guild & Lord, 620 Atlantic avenue. 448 6x9-inch pages; 22 map plates. Price, flexible covered, $2; in cloth, $2.50.

This is a list of mills engaged in the textile and allied industries in the United States and of the buyers of textile fabrics. With the names of the various mills is given information as to capital, officers, machinery equipment and product. The book contains lists of commission merchants, clothiers, etc. The maps will be found a convenience in referring to the location of mills in towns which might not readily be found on ordinary maps. There are some statistics and tables useful in the textile industry. The book has the appearance of covering its subject fully.

"Modern Electric Railway Motors." By Geo. T. Hanchett. 200 6x8½-inch pages with 157 illustrations. Street Railway Publishing Company, New York. Price, $2.00.

As stated in the preface, "The object of this book is to show how electric railway motors are made to-day, and why they are made so," and the order of development of the main features of motor design and construction is carefully gone into for this purpose. The book is largely descriptive, and, except for the last chapter, which gives an outline of the methods and calculations of motor design, it may be read by those having only the most elementary knowledge of electricity. In fact, the purely mechanical features of motors occupy so large a portion of the book that it may almost be said to be mechanical rather than electrical. The author is obviously at home with his subject, and his presentation is instructive and interesting.

For the following important information we are indebted to the "Textile Record": "The use of fans for the mechanical production of draft in industrial steam boiler practice, although not quite a recent innovation, is one which merits considerably more attention than it has hitherto received."

In the building of new factories in the textile industries the first half of this year has broken all records. The number of mills for the first six months was 307, a gain of nearly 70 per cent. over the last half of last year, and eight more than the total for the entire year of 1899.

Commercial Review.

NEW YORK, Saturday, July 28.

ELECTRICAL AND OTHER MACHINERY.

There are several points of trade which together afford ground for hope that the fall revival of buying has already set in. Our Cincinnati and Chicago reports this week both indicate an improvement in business. Some New York pig-iron sellers tell us that they are getting more inquiries and orders than they were, and that whereas a short time ago a sale of 200 tons was exceptional, the lots now in demand run up into thousands of tons. One firm says that there is an excellent and improving export demand, the English demand being particularly strong.

Electrical machinery among the medium-sized concerns has been decidedly quiet of late. One of them reports, however, that it has found a marked improvement of inquiry in the last few days. It is encouraging to note that the trade of the big General Electric Company has continued very good in its lines generally, this being true of railway, power and lighting machines.

Power equipments, as compared with those exclusively for lighting, are absorbing more and more of the attention of sellers of electrical machinery. Three or four years ago the feature of trade in this market used to be isolated lighting plants. But now when a generator is ordered a dozen motors are apt to be purchased with it. That goes to show the prevalence of electrical power distribution in ordinary manufacturing plants. Motor-driven machines are no longer a novelty. This is confirmed in machine tool circles. A seller lately, in attempting to point out the distinctive mark of present business, spoke of the increasing relative number of motor-driven tools.

It is a little early in the season yet to order lighting machines against the winter, and this periodic phase of business has not yet cropped into sight. Among the lighting plants that are to be figured on some time in the future will doubtless be a large one for an eighteen-story building which the Maratime Building Company, recently incorporated, proposes to erect on Bridge street, at the rear of the new Custom House site. This is taller than almost any that has lately been put up, and it seems as if architects might be working back towards the ideas of altitude they held at the middle of the nineties.

Cement mill equipment, which has been enjoying such a boom for the last few years that it has seemed that there must come a tremendous overproduction in that industry, continues. Several enterprises, in particular, have lately come to notice. One is the installation of five 50 horsepower Bullock motors, which the Atlas Portland Cement Company is to have put into its plant at Northampton, Pa. Another is the rebuilding and equipment of the Birmingham Cement Company's plant at Ensley, Ala., lately destroyed by fire, which was mentioned in our Manufacturers Column last week. A third is the proposed plant at Lakeside, near Ithaca, N. Y., noted in the same department this week. This will, it is reported, be an electrically driven mill.

An unusually large export motor order has been afloat in the market lately. It calls for about $20,000 worth of motors for a dealer's stock in Costa Rica.

The Bullock Electric Manufacturing Company has sold eight complete small lighting plants for use on the Chinese & Eastern Railroad. The engines comprise six Forbes and two Skinner. The company has booked a contract for two 750 kilowatt dynamos for the American Sugar Refining Company, of this city.

The Westinghouse Electric and Manufacturing Company is building a municipal equipment for an electric light plant in Hagerstown, Md.

The Kidder Press Company, whose headquarters are in Boston, Mass., has purchased the shops of the Somersworth Company, Dover, N. H., and will remove its plant to that place, where it will make paper mill machinery, printing presses and special machinery. Some new equipment will be put in, and the operations of the Kidder Press Company will be greatly extended.

CINCINNATI REPORT.

Proprietors of the larger and more extensive machine shops in Cincinnati affect to see a very perceptible improvement in conditions; particularly true is this of the manufacturers of machine tools, milling machines, lathes and drills.

Many have just caught up on deliveries booked early in the year, and are consequently greatly pleased over the evidence of coming business. Officers of the Cincinnati Milling Machine Company have had advices from Secretary and Treasurer Fred A. Geier that he and President H. C. Hoeffinghoff, of the Bickford Drill and Tool Company, will return to this country in about a month.

They are making an exhaustive investigation of the possibilities for American made machinery in Europe, and their testimony will be welcomed with considerable interest. The company named has just shipped a lot of seven machines to Berlin, and announces foreign business in a very fair way. Shipments have been commenced by the Bullock Electric Manufacturing Company on the $500,000 contract recently made with a French syndicate for electrical equipment for street railways in different parts of the Eastern hemisphere. Two large generators, 800 kilowatts capacity, go to Alexandria, Egypt; one of 400 kilowatts goes to Algiers, and Lyons, France, gets a large generator. Among important shipments of the Bullock Company abroad are five carloads of apparatus for the Chinese & Eastern Railway, a lot of work for the United States in the Philippines, generators for thirty United States Government transports, and a large printing press equipment for St. Petersburg, Russia.

Jobbers of machine tools and allied lines announce a very perceptible brightening of the buying horizon. Domestic orders, particularly from Southern Indiana and Ohio and Kentucky and West Virginia are on the increase, and as a rule purchasers are investing their money in the better grades of work. Collections are as a rule good.

A number of foreigners have been in Cincinnati figuring on machine tools and wood-working machinery during the past month. As a rule, jobbers report the inquirers as extremely close and sagacious.

President H. M. Lane, of the Lane & Bodley Company, has just returned from Paris. Mr. Lane says prospects are very flattering for his firm over there, and incidentally notes that the English are almost tabooing the show.

CHICAGO MACHINERY MARKET.

The fact that deliveries of boilers of large capacities cannot generally be promised under from two to four months accounts in part for an improvement in present demand, for there are many power installations desired this coming fall, the immediate purchases of boilers thus becoming imperative. Representatives of boiler manufacturers are practically unanimous that business has improved over that of a month ago. Engine builders make similar reports. Prices of boilers are declining slowly, but steadily, values of engines showing little change. In addition to the distinctively better trade, considerable emphasis is laid on the circumstance that inquiries are better to an even greater degree. It is said that some manufacturers are deferring contemplated improvements until next spring, though enough who wish to rush matters remain to give the market a most flourishing aspect. For the delays little regret is expressed, since factories generally have all the work they can comfortably look after. The activity is pretty well scattered and includes all manner of buyers, including manufacturers, municipalities, street railways and miscellaneous users of power.

The Deering Harvester Company is making progress with its new centralized power plant, which is to have an ultimate capacity according to plans of 12,000 horse-power. The company has just purchased from the Edge Moor Iron Company three water-tube boilers of 800 horsepower each, to be used in addition to boilers already in operation. They are erecting a smokestack 250 feet in hight, with 16 feet 4 inches inside diameter, and are now installing the third of the new Corliss engines purchased from the E. P. Allis Company.

The Milwaukee Electric Light and Street Railway Company has purchased from the Edge Moor Iron Company nine

water-tube boilers of 650 horse-power each, or an aggregate of 5,850 horse-power, the boilers to have special superheating arrangements from which it is expected to get 60 degrees of superheat. The E. P. Allis Company is furnishing the engines for this large new plant.

The Russell Engine Company has sold a 250 horse-power engine for an electric plant at Antigo, Wis., a complete lighting plant for installation at Glen Ellyn, Ill., and has sold to John S. Metcalf for export to South America a 250 horse-power engine for elevator service.

Wickes Bros. have sold to the Dells Paper and Pulp Company, Eau Claire, Wis., a 600 horse-power engine and boiler and two 400 horse-power water heaters; also four boilers of 200 horse-power each to the B. & O. Elevator Company, South Chicago Ill., a 125 horse-power boiler for the Robinson-Warner Elevator at Minneapolis, two 225 horse-power boilers to the Indiana Rubber Company, Indianapolis, and one 250 horse-power boiler to the Morden Frog and Crossing Works, South Chicago.

Quotations.

NEW YORK, Monday, July 30, 1900.

Iron—American Pig, tidewater delivery:—

Pennsylvania Irons:

No. 1 X foundry	$16 75 @ $17 25
No. 2 X foundry	15 75 @ 16 25
No. 2 plain	15 25 @ 15 75

Alabama Irons:

No. 1 foundry, or soft	18 75 @ 20 25
No. 2 foundry, or soft	17 75 @ 19 25
No. 3 foundry	16 75 @ 18 50
Foundry forge	16 25 @ 18 00

Bar Iron—Base sizes—The price on dock is 1.40 @ 1.50c. for refined brands, and about 1.90 @ 2c. for same from store.

Tool Steel—Base sizes—Good standard quality, 7 @ 8c.; extra grades, 10 @ 14c.; special grades, 16c. and upward.

Machinery Steel — Base sizes — From store, 1.90 @ 2c.

Cold Rolled Steel Shafting—Base sizes —From store, 3 @ 3¼c.

Copper—Lake Superior ingot, 16½ @ 16⅝c.; electrolytic, 16⅜ @ 16½c.; casting, 16¼ @ 16⅜c.

Pig Tin—33¼ @ 34c. for 5 and 10-ton lots, f. o. b., brokers quoting with some discrepancy.

Lead—For wholesale lots, 4c., with .02½ @ .05c. extra for carloads, New York.

Spelter—Prime Western, 4.25 @ 4.30c., New York delivery.

Antimony—Cookson's, 10¾ @ 11c.; Hallett's, 9½c.; United States, 9⅜ @ 9½c.

Lard Oil—Prime City in 1 to 5-barrel lots, 55 @ 57c.

Echoes From the Oil Country—III.

The joint turner seemed to take first place in the shop, and Walter held that position, while Billy was general hustler—went out on jobs, did general work inside, bossed the "kids" (there were two, Sam and Joe) and the laborer, and would tackle anything, even a joint on occasion; but he did not claim to equal Walter at that.

Walter's work was new to me, and I was much interested in watching him and listening to his ideas in regard to it, and the more I saw of it the more my respect for him increased. There are joints of various sizes, as 4x5 inches, 3x4 inches, 2x3 inches, etc., the sizes being the diameters at the two ends. I will describe the 2x3, or "standard," as it was called, it being the original and the one mostly used.

A pin forging is about 18 or 20 inches long. One end is about 3½ inches diameter, roughly tapered, reaching that size about 4 inches from the end, the end being about 2½ inches diameter; then comes a round part, about 4½ inches diameter and about 5 inches long, the rest being about 3¾ inches square.

Walter ran the 24-inch lathe. It had a taper attachment on the back, of the usual style. He would take a forging, set it up on the square end and put a deep center-punch in the other end, enlarge it with a heavy center-punch that had been a lathe center and was in good shape, drive the slim center-punch in deeper, enlarge again, and, putting in a little white lead, swing it into the lathe with the square end in the chuck, which was a good, heavy one.

To face off the end at an angle of about 10 degrees was the work of a very few minutes. Next the large part was turned down to 4¼ inches diameter with a rough cut and a water finishing cut. The taper attachment was thrown in, and carefully setting a tool to a mark on the tail spindle for hight, a cut was started at the point with a taper of 1 inch in 3½ inches of length.

"Now, you just be careful to turn this a little too small to get it just right, for if you get it too big you get stuck, and it takes longer to get it right than if you made a new one; but if you get it too small you are all right, unless you get it too awful small, and even then you can't spoil it," says Walter; while I began to look around and wonder where he kept his "putting on" tool, that so many machinists had at various times so ardently longed for, but had so seldom been able to find.

A finishing cut made this part 2 inches in diameter about ⅛ inch back from the end, and the cut was run up about 3¾ inches. A square-nose tool was run down facing up the shoulder to about 3⅞ inches from the end, and ran it to 3 inches diameter. This left a straight part about ⅜ inch long where the taper ran out.

Next, a thread tool was put in and set on the center by the mark on the tail spindle and square with the center line of the lathe, and with the lathe geared for eight threads to the inch, three roughing cuts and two finishing scrapes left a beautiful thread as close up to the shoulder as possible.

A piece of pine stick cleaned out the thread; the tailstock was run back and a piece of box screwed on as far as it would go by hand, which was within about ⅜ inch of the shoulder. The tailstock was run up again and a side tool run in and the shoulder faced so that a ½-inch gage-piece would just slip in.

"You see," said Walter, "if I had got it too big I would have to try to scrape that thread, and likely the tool would dig in trying to get through the finish, and then I would get it too awful small trying to get a smooth thread, and then I would have to face back the shoulder; and knowing I was losing time, I would get in a hurry and face it off too much, or else, for fear I would get off too much, not get off enough and not be able to get the gage box on, and so monkey around and finally get mad and turn off the thread and face back the end and shoulder, and thread up all over and have a big nubbin to chip off the center, and that would leave this pin without a center, to bother me if it ever came back for repairs.

"Yes, sir, I tell you they are just 'hoodoos' if you get them too large. Always turn them small and you're all right. And be careful of your thread, so that your gage fits true, or your joinst won't stay.

"You see, if your box and pin are screwed together and don't shoulder up together and the driller and tool-dresser jump at the end of a 6-foot bar that has a pry on the end of a 5-foot wrench, trying to get them up, they may twist them off; and if they go up too easy, the first few blows of the drill will drive the shoulders back, and they will either unscrew or break off and leave something in the hole, and that means a job of fishing, with your fish maybe 800 or 900 feet down in a hole, and stuck."

While Walter was talking he had removed the pin from the lathe, and was putting in the next one, which he had centered while the cut was going across the collar of the first one. I found that ten or twelve pins were a good day's work, and began to suspect that Walter earned his $3.50 per day.

The boxes that matched the pins were drilled and bored from the solid; the outside was first turned and then run in the steady-rest. In this case the hole was bored large, and then, after threading, the box was faced back to size with a gage pin and gage. Six boxes were considered the equal of ten pins.

Some day I will try one, if Walter goes fishing and Billy and the boys are both out on a job. It looks easy, watching Walter standing around and whistling and eating apples and throwing the cores at the cubs, but I would rather not have too many spectators when I try.

W. OSBORNE.

A Micrometer of the Orient.

BY OBERLIN SMITH.

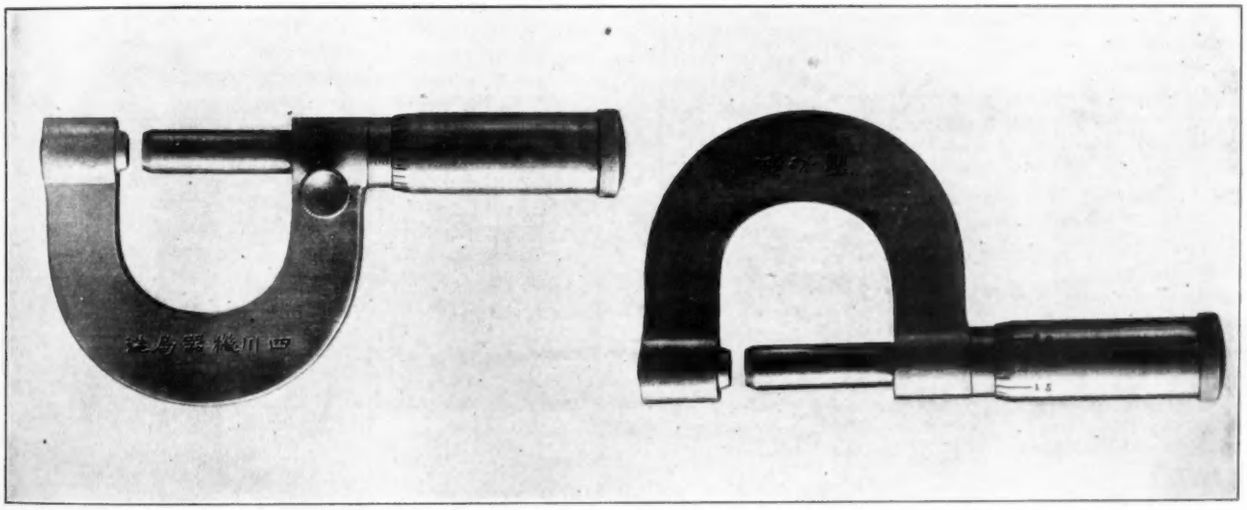
The half-tones show, respectively, the two sides of a 2-inch micrometer caliper (after Brown & Sharpe) which will probably look rather familiar, and provoke some curiosity as to why such a very commonly used tool should be illustrated in this connection. A closer inspection, however, will show that the tables of the translation of sixty-fourths of inches into thousandths, which are now usually stamped upon the sides of these instruments, have been entirely omitted, and in place thereof certain Chinese inscriptions have been stamped, the meaning of which is possibly not entirely clear to the ordinary observer; but "thereby hangs a tale."

The micrometer from which these pictures were photographed, now lying on the writer's desk, is a very fair working instrument, although, of course, not so accurate as its prototype made in Providence, from which it was copied, and which is now in use in a machine shop in the interior of China, nearly 2,000 miles westward from Shanghai. This shop runs some fifty or sixty men and is attached to the Government Arsenal and Mint at Chentu. These machinists, as well as their gang bosses, foremen, superintendent and general manager, together with the 400 or 500 other operatives of the establishment, are all native Chinamen, with no English-speaking people about them, there being no Europeans except a few missionaries (if they are still alive) in the whole of the city mentioned, which has a population of some 800,000.

The American micrometer was exported in the pocket of Mr. Henry A. Janvier, who, a year or two ago, was sent to China by the writer, to help finance that country by superintending the erection and running of certain coining plants for making all the new silver and brass coinage of the Province of Szchuen. The very intelligent shop superintendent, Mr. Wai, whose name appears in his native language in one of the inscriptions referred to, was delighted with the Brown & Sharpe micrometer, never having seen one before, but fully appreciating its usefulness He borrowed it at numerous intervals extending over a period of six weeks, not always returning it when it was wanted without some urging. At the end of that time he brought Mr. Janvier the instrument of the pictures, with a request that a "swap" be made. This proposition was favorably considered, as a tool of this kind made by native machinists, who had never seen one before, and entirely by hand, or with the ordinarily crude machine tools attainable, was indeed too much of a curiosity to ignore. The contract, therefore, was gleefully executed by both the parties of the first and second parts.

It will probably be a surprise to many of the readers of this article, as it was to the writer, that so good mechanical work as this is, and as are the tools which are constantly being made for arsenal work, can be produced by native brains and labor in the out-of-the-way location referred to. It is true that the old-fashioned, crude machine tools and engine in use in this arsenal were made in Europe, and that sometime the Chinamen may have been instructed in their use, but it is a certain thing that the Orientals seem to take kindly to accurate mechanical work, providing they do not have to design it themselves.

When the coining machinery in question had been set up and started, there seemed to be no difficulty in teaching the native workmen, in a few days' time, to operate it successfully, or to take it apart, put it together, adjust it and repair it. One of these days, should all China become full of "open doors," it would seem as if a very big field would spread out for the reception of American machine tools of all kinds.



MADE IN CHINA.

Openings for American Machinery in British India.

Though during the past twenty years the engineering industries have increased to a great extent in India, and though the country is much less dependent upon importations from foreign countries than was formerly the case, yet the imports of machinery and machine tools are very large. This is best illustrated by the official statistical returns, according to which British India imported in 1899 machinery and mill work to the value of $9,150,000, against $8,400,000 the previous year. Besides this, there were imported during 1899 railway plant and rolling stock to the value of $8,470,000, against $8,120,000 in 1898.

In the first item, viz., machinery and mill work, are included agricultural machines, steam engines, portable engines and all other industrial machines. In the second item, viz., railway plant and rolling stock, are included locomotives and tenders, passenger and freight cars, construction material, rails, fish plates, sleepers and keys.

Up to the present time the great bulk of all the machinery imported into British India has been supplied by Great Britain, and only to a relatively small extent have Continental countries contributed, though, especially during the last few years, Germany and Belgium have made strenuous efforts to gain a foothold on the Indian market.

During the last fiscal year our exports of machinery to British India consisted chiefly of locomotives; we sent thirty-six locomotives, valued at $408,950, to India.

Although British India has so far not offered much of an opening for agricultural implements, the imports are increasing from year to year, having amounted in 1899 to several hundred thousand dollars, and, as in all other machinery, Great Britain takes the lead. Our share in this line amounted to only $6,701. American agri-

cultural machinery has, in every field, shown itself to be the best in the world, and therefore nothing but effort seemed to be needed to gain a proper share of this trade.

In connection with agricultural machinery we may mention that India is one of the most important cotton producing countries in the world, and therefore there is a constant demand for cotton gins, which demand has so far been met almost entirely by Great Britain.

As is also well known, irrigation works are of great importance and extent in India, and there is, therefore, a continual demand for windmills and pumps. Our total exports of pumps and pumping machinery in 1899 amounted to the insignificant item of $30,820.

Great strides have also been made during recent years in India in electrical industries. Great Britain has had the lion's share of this trade, our exports having been in 1899 $13,929.

Machine tools are almost entirely of British origin. Our total exports of metal working machinery in 1899 to India amounted in value to only $7,003.

The iron industries of India have received a considerable impulse since an understanding was arrived at with the governments in 1891, by which structures made of imported iron or steel bars or plates were recognized, for purpose of purchase, as having been "made in the country."

In this, as in every other case, it is of the highest importance that the intending exporter should carefully study his market, and should send only what is likely to find sale. It is the old story, which cannot be too often repeated, that the manufacturer is not an educator, to teach people what is best for them, but a purveyor, to sell them what they want. Such success as has been already attained in this market has been achieved only by following this plan. As an example we may mention the matter of plows, in which some American manufacturers have been of late very successful, and are ousting other makers from the market, because they have made a light, simple instrument which did not arouse the prejudices of the Indian population, although at the same time infinitely superior to the native instrument.

Machine tools continue to be imported in constantly increasing numbers, and the preponderance of screw-cutting lathes over hand lathes is a remarkable feature in a land where labor is cheap and capital in small workshops not over plentiful. The smaller kinds of machine tools, such as band saws, screw presses, drilling machines, etc., are made in a rough fashion in some workshops, but a general preference seems to exist in favor of those of foreign workmanship.

Engines and boilers are chiefly of English origin, though the smaller kinds of engines can now be made in Calcutta, Bombay, Madras and other cities. Our total exports in 1899 amounted to nine stationary engines, valued at $3,231, while our boiler exports during the same year amounted in value to only $6,172.

In conclusion we may state that during the last fiscal year no less than 14,186 sewing machines were imported into British India, of which 10,081 came from Great Britain, 2,971 from Germany, 515 from Belgium, and only 204 from the United States. H. L. G.

A Spring Coiling Machine.

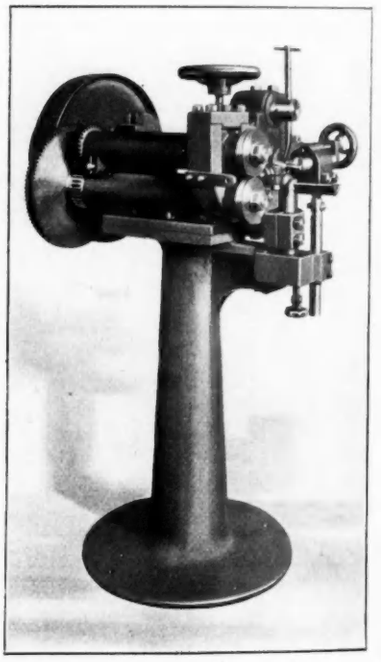
The accompanying half-tone shows a machine for coiling helical, or, as they are familiarly but not correctly called, spiral springs of steel, brass or other wire. The springs are rolled out continuously, and may be cut off to any length required. There are two styles of the machine made, differing somewhat from each other in their construction and mode of operation. There are also two sizes of each style of machine. In the larger machine, as here shown, an arbor or mandrel is used, while in the smaller machine there is no mandrel. This mandrel is made small enough in diameter for the inside of the smallest spring made, and the same is then used for all larger sizes. The coil of wire from which the springs are to be made is placed upon a conveniently located reel, and the end of the wire is passed through the hole in the guide in front, and then it passes between the grooved feed rolls. The shafts which carry these rolls are geared together, and they run at the same peripheral speed as the mandrel. The rolls are adjusted to squeeze the wire sufficiently to drive it through the bending operation. There are two rolls, approximately 90 degrees apart, which press the wire against the mandrel and give it the necessary curvature as it moves along. The adjustment of these rollers, which may be made or corrected without stopping the machine, determines the diameter of the spring. The spacing of the wire is done by the spacing finger standing vertically above the mandrel. Without the finger a close-wound or pull spring will be produced. The housing carrying the feed rolls has a vertical adjustment allowing the wire to be fed in above or below the mandrel, thus producing either right-hand or left-hand springs.

On the smaller machines the bending is done by means of three rolls, these being adjusted so that their peripheries locate approximately a circle corresponding to the outside diameter of the spring to be wound, and the mandrel is not required. Springs with an inside opening as small as the diameter of the wire have been wound by the smaller machines. The machines run at a wire speed of 40 to 60 feet per minute, according to its diameter. These machines are built by Rudolphi & Krummel, North Clinton street, Chicago.

Micrometer Heads on Lathe Cross Feed Screws.

While the use of divided heads on the cross feed screws of lathes is gradually extending, the advantages of the construction are not appreciated as they deserve to be. This is the more remarkable as the universal use of such heads on grinding machines has shown their great convenience and familiarized mechanics everywhere with their use.

We are led to make these remarks by the fact that J. T. Slocumb & Co., of Providence, R. I., have found it profitable to equip all their lathes with this feature. They criticise the heads usually supplied for this purpose on account of their small size. Their practice is to remove the crank from the screw and to replace it with a dial of about 5 inches diameter for most lathes; this dial being graduated on its periphery and made to carry the handle which is removed from the crank. The quill between the apron and the old crank has a straight seat turned upon it, and on this the zero pointer is mounted and held by a split grip adjusted to permit the easy movement of the pointer for adjusting the zero. These divided heads are used in connection with the micrometer calipers. After the work is rounded up, the size is measured by the caliper, and the amount remaining to come off is determined; the tool being then adjusted for this amount by means of the divided head on the lathe screw. Of course, for accurate results, the point of the tool must be set in line with the lathe centers. Advantages are, however, found to attend the use of the heads on other work than simple turning. Thus in cutting screws the chips can be made lighter by a defined amount as the



A SPRING COILING MACHINE.

cut gets deeper. Again in making several pieces of a kind it is easy to finish them to the same size, and in cutting recesses in inside work, in places where measuring is difficult, the tool can be adjusted to some size which can be easily reached and measured, and the other sizes can be obtained by the dial. In general, the method reduces the cut-and-try element of lathe work.

Of course too great dependence must not be placed on the dials, as the cross-feed screws of lathes are not usually made of a high degree of accuracy, and hence they cannot be used for obtaining long movements accurately in this way. By the use of the micrometer calipers in combination, the use of the feed screw for measurements can, however, be confined to short movements for which it is usually accurate enough for most purposes.

For a screw of eight threads per inch the dial is graduated into 125 divisions giving thousandths—each fifth line being extended—and a thousandth division on the pointer is also divided into quarters, so that an adjustment of the tool by one division reduces the diameter of the work by half a thousandth.

Armor Plate in Great Britain and Elsewhere.

In Great Britain, as in the United States, the armor-plate industry is in the hands of a few firms, notwithstanding that it is admittedly a profitable business. The reason for this may easily be found in the fact that the plant equipment is so expensive. In Great Britain there are only four firms engaged in the industry, three of these in Sheffield and one in Glasgow, with a fifth being laid down in Manchester, which is expected to be as well equipped as any of the others. France has five different establishments; the United States and Germany each two, and there are plants in Austria and Russia. A few years ago evidence was produced before a Senate Committee to the effect that each of the armor-plate plants in the United States cost $4,000,000. At the same time it was stated that each ton of armor plate cost $250, without any allowance for profit. And year by year the expense is increasing as the armor is becoming heavier. It is stated that the present capacity of the armor-plate plants of Great Britain is in the neighborhood of 50,000 tons per annum; and this would provide for the building of twenty first-class battleships each year, supposing that each ship would require from 2,500 to 3,000 tons of armor. At the present time the Royal dock yards and private shipbuilding yards in that country have on hand thirteen first-class battleships, with a total displacement of 184,850 tons, which will call for about 40,000 tons of armor. The cost of the armor for a first-class battleship in England is put at $1,000,000 to $1,250,000, or about one-third of their total cost. The total cost of the armor required for the battleships now being constructed in Great Britain is placed at from three and one-half to four million pounds sterling.

A. F. T.

A Novel Speed Varying Device.

We show herewith a new speed controller, with some of its applications, and it will be seen to possess decided points of novelty.

Fig. 1 shows the controller detached or arranged as a countershaft, and Fig. 2 shows a horizontal section of it from which its principle of action will be more plainly seen. Referring to the latter figure, *a a* and *b b* are the opposing and mating pieces of taurus form, they being in general of disk shape, but not flat. The opposing inside faces are machined to the shape shown, the centers of the circular sections being at *c* and *d*. Disk *a* is keyed to the shaft, but disk *b* is secured to a quill which revolves independently of the shaft and may slide slightly upon it. In frictional engagement with disks *a* and *b* are the disks *e f*, mounted in bearings *g h i j*, which are carried by yoke castings shown more clearly in Fig. 1. The yokes are in turn swiveled in the frame and are connected by segment gears *k l;* the left-hand yoke having also a segment gear *m*, which, by a pinion *n* and handle *o*, may be turned about its axis at *c*, and thus the disks *e f* may be made to occupy various angular positions, and thus transmit any speed between the assigned limits from disk *a* to disk *b*—the direction of motion of *a* and *b* being, however, opposite. In the position of *e f* shown in Fig. 2, the speeds of *a* and *b* will be the same, but *a* being supposed to be the driver, the inclination of *e f* in one direction will increase the speed of *b*, while their inclination in the opposite direction will decrease it. At the left of Fig. 1 and at the bottom of Fig. 2 a toggle-joint connection between shaft and quill will be seen, by which disks *a* and *b* can be made to approach each other, and thus squeeze the disks *e f* between them. By the action of the toggle the device thus acts as a countershaft to stop and start the motion, while by the action of the disks *e f* the speed is varied. It will be seen that when the toggle is closed there is no resulting exter-

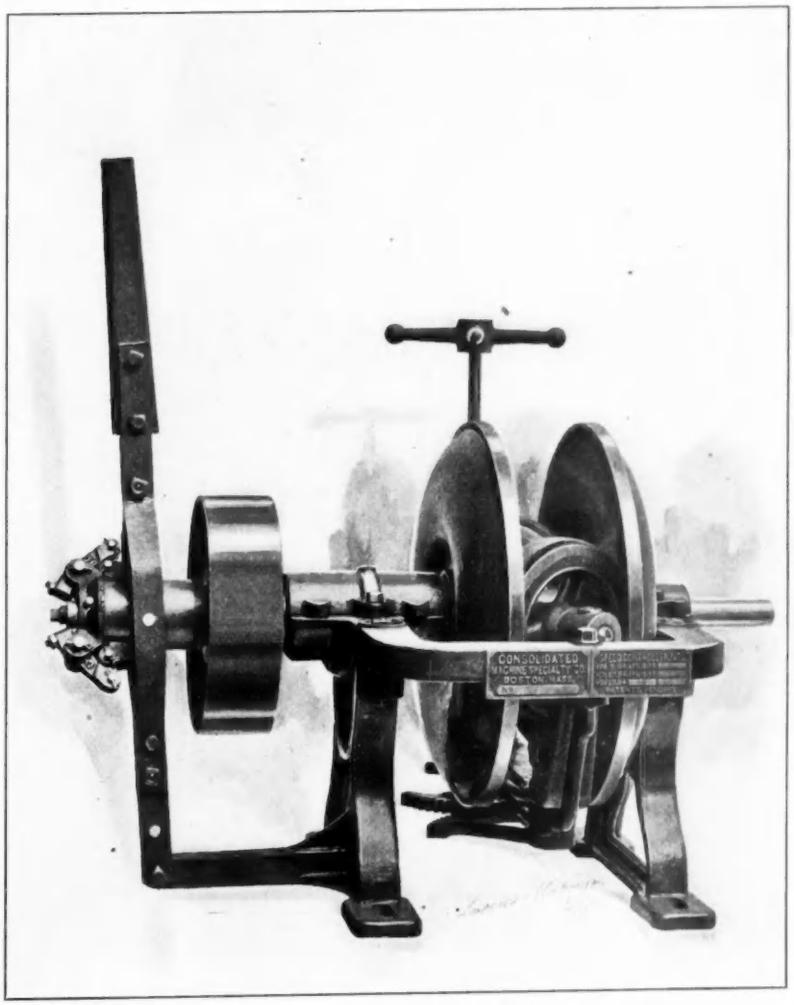


FIG. 1. SPEED CONTROLLER ARRANGED AS A COUNTERSHAFT.

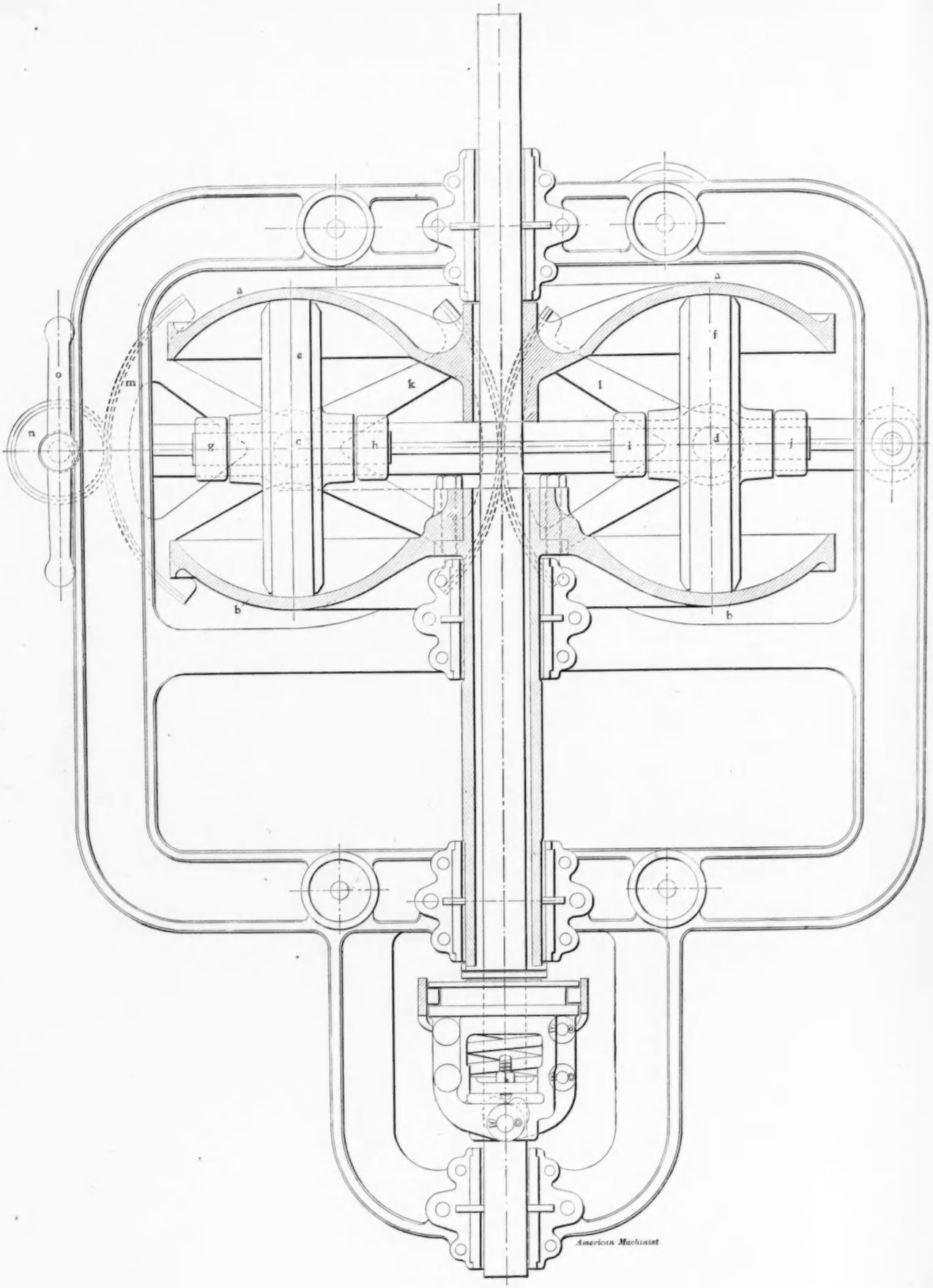


Fig. 2

HORIZONTAL SECTION OF CONTROLLER.

nal thrust in either direction—the thrust on the shaft balancing that on the quill. Neither is there any tendency to tilt the disks *a* and *b* or any appreciable pressure on the bearings of either the main shaft or of the disks *e f*.

Fig. 3 shows how the disks *a b* are made, as well as an interesting application of the device to the driving of a lathe, which in this instance is of 40 inches swing. The tool will be seen to be mounted on a tool-post which swivels, but does not travel crosswise of the lathe, the point of the tool thus sweeping out the required curve.

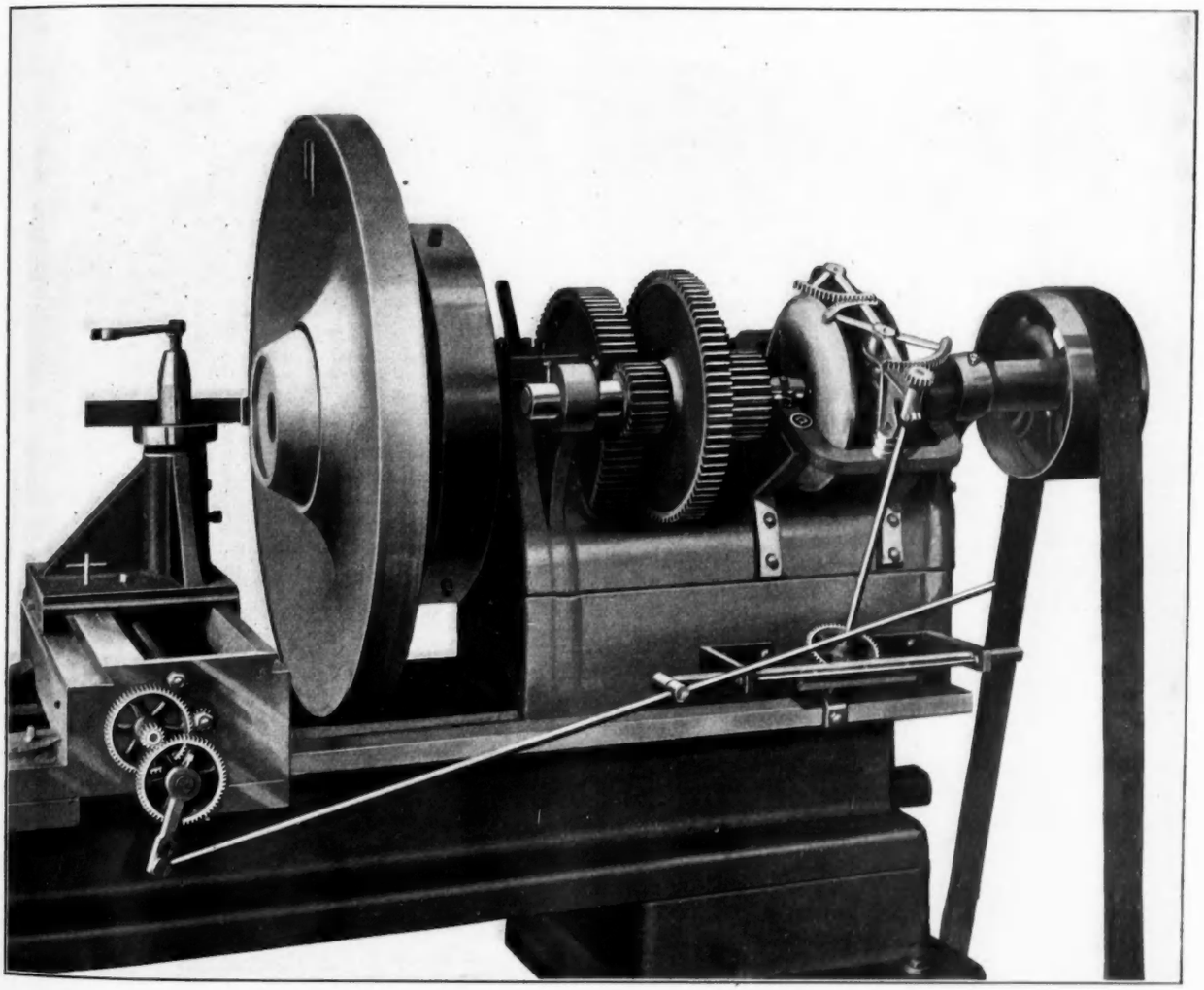


FIG. 3. THE CONTROLLER APPLIED TO ITS OWN MANUFACTURE

This swiveling of the tool is automatic, and by the gears and rod connection, plainly shown, this swiveling motion is communicated to the controller which drives the lathe, and the lathe is thus speeded up as the tool approaches the center.

Figs. 4 and 5 show the controller applied to drill presses, the former application being to the driving spindle only, the feed being by hand, while in the latter case the application is to both the driving spindle and the feed. Fig. 6 shows an application to a centrifugal oil separator, the feature in this case being that the separator is started by closing the toggle when the controller is adjusted to deliver a slow speed which is then gradually increased to the point desired.

The device is the product of the Consolidated Machine Specialty Company, of Boston, and is being marketed by the Niles Tool Works Company.

Another striking instance of the manner in which American courts interpret laws as to employers' liability is to be found in a recent issue of the "American Machinist." A workman was engaged in truing up a grindstone with a length of iron gas pipe. Evidence was given showing that the bearings of the stone were set too high, thus rendering the pipe liable to be caught in. This, in fact, happened, and the workman's hand following he lost three fingers, for which he claimed compensation. The court decided that the risk arising from the position of the stone was obvious, and was accordingly assumed by the plaintiff, and that being so, it was of no consequence that the defendant might have conducted his business with more safety.—"Engineering," London.

Training Students in the Principles of Scientific and Commercial Founding.*

BY THOS. D. WEST.

For some eight years or more attention has been called by writers to the desirability of colleges training students in the art of founding. A few colleges have fitted up departments for such training, and, in some instances, have adopted the writer's works to assist them in imparting instruction. Mention is made of this fact at the start merely to show that there is a want, and that some colleges are making an effort to fill it.

While there has been this awakening lately to the scientific methods and to the skill involved in successful founding, and while many bright minds are striving to elevate the trade, its progress is hindered in one way by reason of specializing in the manufacture of castings. This most seriously limits the opportunity to obtain the full knowledge and experience formerly within the reach of nearly all who were

*From a paper presented at the Chicago meeting (June, 1900) of the American Foundrymen's Association.

engaged in the manufacture of castings, for the founders of the old days generally did a jobbing business.

The lack of the all around operations of the past, which afforded an opportunity to get a broad knowledge of the art of founding is apparent to broad experienced molders and founders in altogether too many articles appearing at the present day. A volume could be filled with different examples of the evils resulting from the ill conception of the knowledge, judgment and skill required in founding, and only obtainable by broad schooling in the art. The question is, how can steps be taken to remedy such evils and prevent matters from going from bad to worse? We can expect little assistance from the specialty shops, for, even if they did make an effort to give the broadest education possible, it would be poor, at best. We must look in other directions.

What will seem strange to many is the inability of most of our present shops to give those who are coming along the knowledge that should be obtainable. Yet this is readily understood by experienced superintendents or foremen of heavy-work foundries; for in all such shops the ordinary founder or molder, although he may work a lifetime, day in and day out, alongside the leading men, can never be brought to half realize what experience, skill, judgment and caution are requisite in order to make a founder or molder one to be recognized as a leader in the art. It is chiefly to the principles of heavy founding that we must look for the education of any desiring a thorough knowledge of the art of founding; and the more varied the knowledge they have of the principles underlying work in green sand, dry sand and loam molding, the more thorough they will be, and the better fitted to assist in protecting and advancing the art of founding.

It will be noticed that an understanding of the principles involved in founding, and not the possession of experience, is cited above as aiding the founder to achieve desired results. Of course, if we can possess an understanding of principles, combined with experience, the better qualified we are for understanding and following the pursuits of the founder or molder. It will seem strange to those inexperienced in founding to be told that a founder or

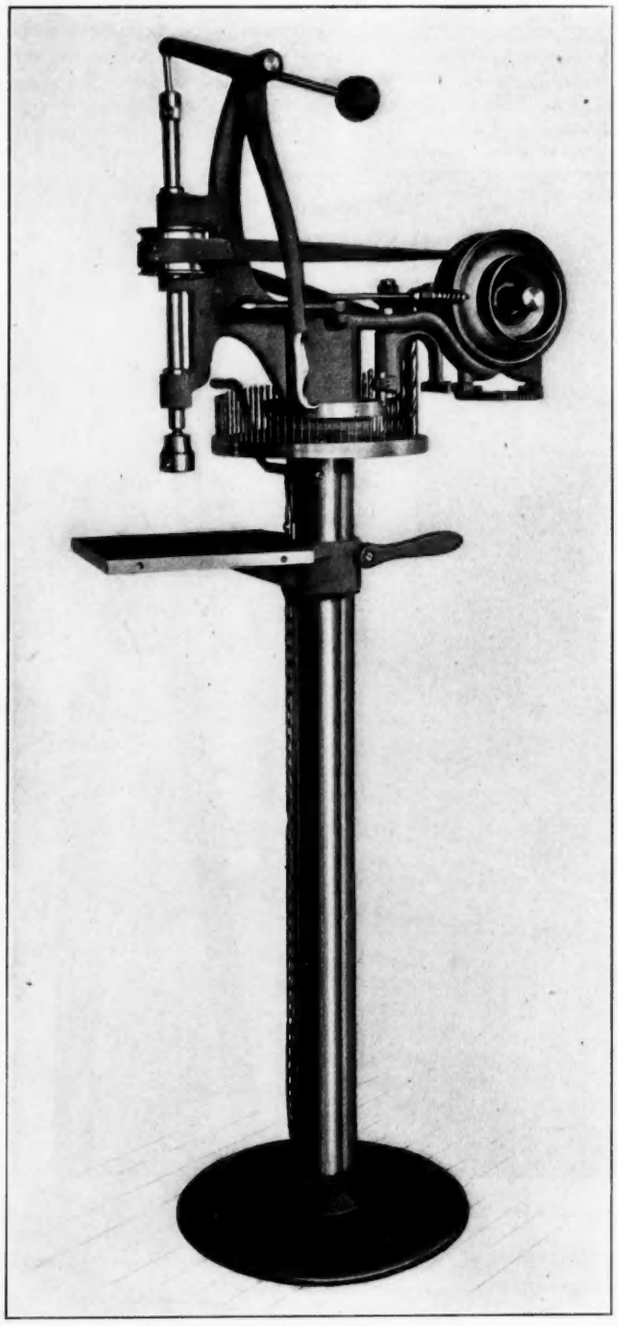


FIG. 4.

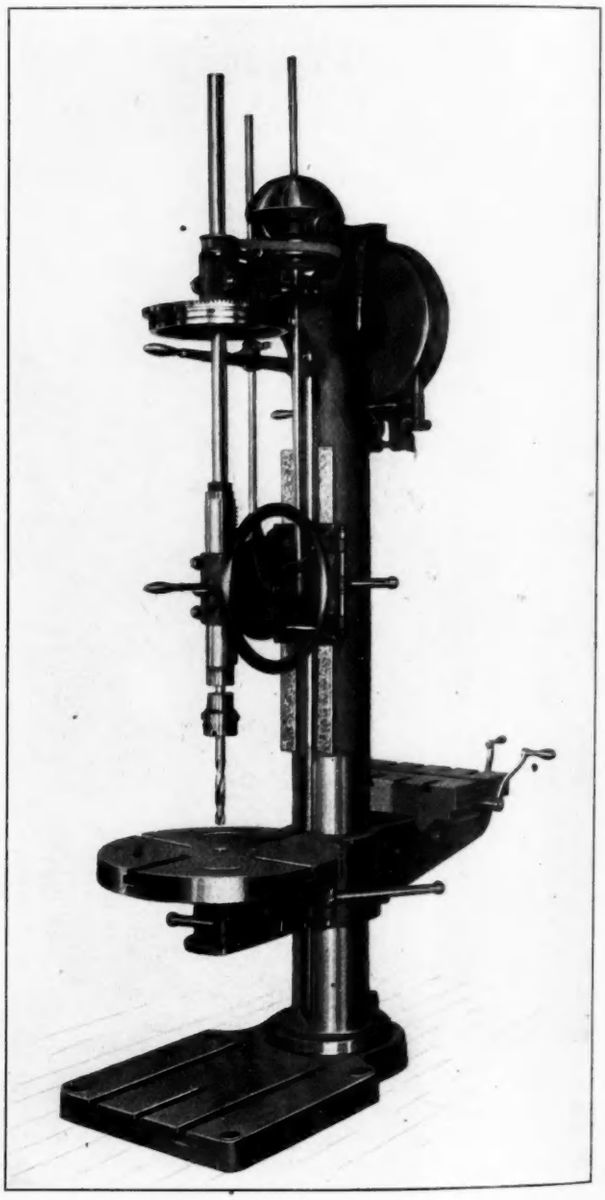


FIG. 5.

THE CONTROLLER APPLIED TO DRILL PRESSES.

molder can be experienced in doing actual work and still lack knowledge of the principles involved in the art or in the work that he may have in hand; but it is a fact, and there are many examples. What successes such founders and molders have had have been greatly due to their imitating those gone before, whose knowledge had been obtained largely by sad and most expensive experience. This experience in many cases could have been avoided had the founder or molder understood the principles involved in the work at hand. It is here that the value of foundry literature is displayed, as by its means one man's studies to discover principles can be transmitted to others and enable them to be benefited by their disclosures. Foundry literature largely supplies the means of saving foundry practice from decay, due to specializing in the manufacture of castings. This tendency to decay might, at length, cause all-around founding to be numbered with the lost arts, and bring great injury to its commercial interests through uninformed competition. The worst evils of to-day are to be found in the inadequate conception that would-be founders entertain of the difficulties awaiting inexperienced men who enter the foundry business.

We have several works on founding which those desiring to acquire the principles involved may study with profit. But that these works may do the greatest good, it is necessary to have opportunities whereby the principles of founding can be exhibited in actual workings. How best to do this is a question on which the writer has views to be expressed later on. Some may advise a novice or student to secure an opportunity in one of the few general casting shops. This would work very well, providing instructors could be obtained who understood the principles of the work they were doing, and had the ingenuity to originate methods of teaching them; but, as explained above, founders and molders, as a rule, have depended more upon shop experiences than upon a study of the underlying principles in attaining what proficiency they possess. For the man who intends to earn his living by actual work on the floor or at the cupola, a certain amount of actual shop experience is necessary, and by being a good observer and following methods taught by skilled hands he gets along without possessing much knowledge of principles. But for the man who aims to be a writer, proprietor, president, general manager, chemist or designer of foundry work, it is very essential that he, at least, understands the principles involved in scientific and commercial founding. If this cannot be obtained in the shops of general foundries, then I would suggest that colleges fit up so as to give opportunities for such instruction.

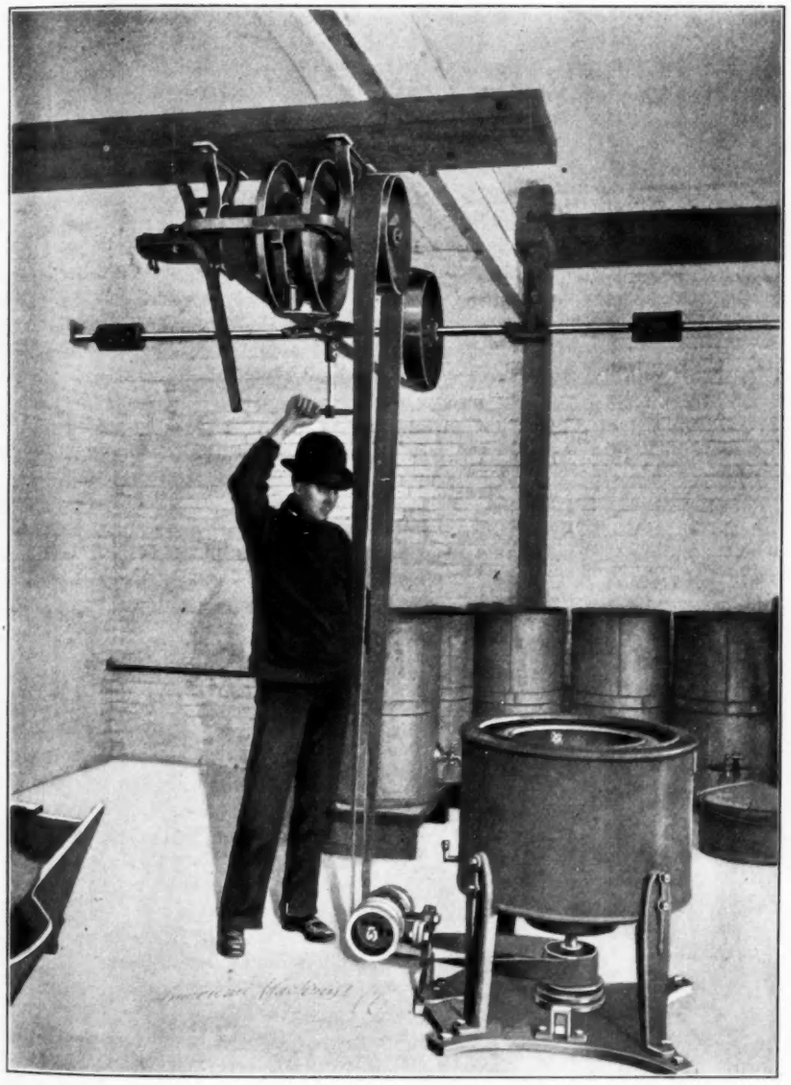


FIG. 6. THE CONTROLLER APPLIED TO A CENTRIFUGAL OIL SEPARATOR.

Why should not colleges equip their graduates in the science and art of founding, as they do in machine shop or blacksmith work? Many graduates of the past wish they had had such a foundry training. There are very few presidents or general managers of iron works having foundries but feel at home in the machine or blacksmith shop, and would like to do so in the foundry. But as to the latter, they are generally dependent entirely upon the judgment and management of subordinates, which arrangements, as a rule, give the head officials more worry, trouble and losses than all else under their charge. There is no good reason why colleges could not give instructions in scientific and commercial founding that would be of great practical value to the graduate, whether he be a mechanical engineer or a chemist.

What is required of colleges at the present day is that their courses in founding be so laid out and systematized as to impress upon the student in a lasting way what is practical and meritorious in all that pertains to general founding. Then, when the graduate passes through a foundry in after life, his equipment will be such as to give him a fair understanding whether work is being properly done, and when trouble arises enable him to assist in devising remedies. He should be able, also, to judge of what is meritorious in the writings of those laying claim to experimental knowledge of founding. The evils of the present methods of college instruction in founding are similar to those of the specialty shop, in that they afford but a smattering of what is true founding, and result in the same injury to the trade that is now found on every hand by reason of the general lack of a more thorough and broader knowledge.

In college instruction it is not necessary that castings of every character should be made, or, for that matter, castings of any great weight. What is wanted more is a course of instruction which will demonstrate good and bad results by different methods in the molding of green sand, dry sand and loam work castings, with explanations for both conditions, to be followed by illustrations of the principles involved. Such work, if properly carried

out, as it can be, would give an impetus to the advancement of the foundry art such as we have not known.

Establishing such a foundry school for the creation of competent managers would be a laudable work for anyone who could donate from $30,000 to $50,000, whether given to colleges or to the American Foundrymen's Association, to be properly placed. Having such a donation to start with, an institution could be carried forward to be a great credit to the donor, to the trade and to all others interested in its success. An institution for the technical training of students in the principles of scientific and commercial founding would naturally create a strong rivalry between the technical and practical men for high-paid positions. If practical men would strive more to understand the scientific basis of commercial founding, as the students would do under the plan herein advocated, and add a mastery of the science to their shop experience, they need never fear the technical man replacing them. If, on the other hand, they are going to remain asleep and not keep up with the progress of founding, as appears, for example, in the slowness of many foremen and molders to study the making of mixtures by analysis and to labor to understand cupola work, the practical men will find it merely a question of "the survival of the fittest." It will be but a little time when they will have to take a back seat and become nonentities in the estimation of the mechanical world, never commanding any pay above the ordinary mechanic. The writer has seen this danger for some years, and in preparing literature has sought to put means in the hands of practical men whereby, with a little study, they could hold the supremacy. It is my hope that this paper may be the means of awakening many from the indifference they are at present exhibiting to the forces that are slowly relegating many of the so-called "practical" men to the rear.

It is for the best interest of the trade that every means be used to induce the practical man to become a capable manager of the mixing of metals by analyses and a master of cupola work, as well as of the floor. The foundry which is compelled to divide such responsibilities is lacking in internal harmony and economy of production, as cited in the beginning of this paper. Such advancement for the practical man need not injure the technical man's chances of congenial and remunerative occupation, for there is room for him at the top as president, consulting or designing engineer or chemist. For in any of these positions, when thoroughly conversant with the principles of scientific founding, he cannot but be of greater value to his firm, and success will be more pronounced when he is seconded by the practical foundry superintendent or foreman, who always prefers to be under the supervision of a president or general manager possessing some practical knowledge of founding.

In connection with the above paper the following resolutions will be of interest. They were adopted at the April meeting of the Pittsburgh Foundrymen's Association:

"*Resolved,* 1. That the foundry industry has arrived at a point where there is a demand for managers properly trained in the principles of scientific and commercial founding.

"2. That a representative body such as the American Foundrymen's Association be requested to draw the attention of the institutions of learning in the country to this fact, and urge them to take the necessary steps to supply the demand.

"3. That the Pittsburgh Foundrymen's Association authorize the appointment of a committee of five, acting in conjunction with committees that may be appointed by other foundrymen's associations, to memorialize the American Foundrymen's Association in accordance with the above resolutions."

A Jig for Drilling Cams.

BY J. V. WOODWORTH.

The cams to be drilled, Fig. 1, were of brass, 9-32 inch thick, cut from a bar of 1-inch round stock, the cutting off being done in the Monitor. They were to be drilled eccentrically, as shown, with a 11-16 inch drill. Of course, to drill a hole of this size in pieces so small and have all approximately alike necessitated a jig that would hold them correctly and securely. The jig is shown in Fig. 2, with a top and an end view, the top view with the plate for holding the bushing off, and Fig. 3 shows the plate and bushing.

A casting was used for the jig proper, with two wings as shown, so that it could be set true and strapped on the drill table. After being planed on the top and bottom, the plate, Fig. 3, of machine steel ⅜ inch thick by 2⅜ inches wide by 3 inches long, was got out and fastened with four flat-head screws *J* and two dowel pins *K*. A bushing *L*, of tool steel, with a 11-16 inch hole, was then made, hardened, ground and lapped. The casting, with the plate in position, was then set on the face-plate of the lathe and a hole 11-16 inch in diameter bored straight through at *E*. The hole in the plate was then bored out so that the bushing would just drive in. The plate was then removed without disturbing the casting and a piece of turned steel 11-16 inch in diameter, with a prick-punch mark exactly ⅛ inch from the center, as shown at *M*, Fig. 4, driven into the hole *E* in the casting tight enough to keep it from turning. The casting was then moved sidewise on the face-plate until the prick punch ran true. The piece of steel was then removed and the hole *E* rebored to 1 inch in diameter and 9-32 inch, full, deep; that is, so that the work, Fig. 1, would enter freely. The casting was then removed from the lathe and a slot planed in the way shown at *N*, Fig. 2; that is, 1⅛ inches wide at the front and running into the hole *B* as shown. A piece of

Fig. 1

Fig. 4

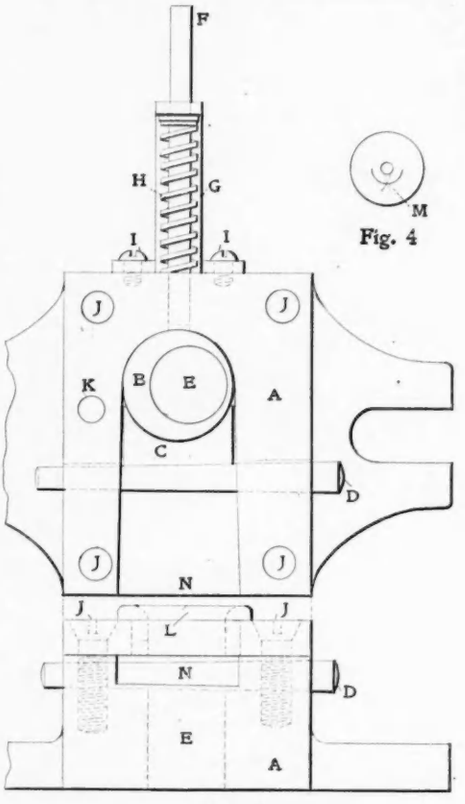


Fig. 2

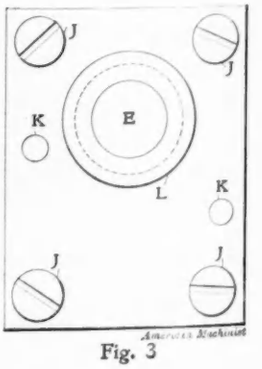


Fig. 3

JIG FOR DRILLING CAMS.

steel *C*, 9-32 inch thick, worked out in the way shown to keep the work from being bruised, was then made. A 5-16 inch taper hole was drilled in *A* to admit the lock-pin *D*, which was of Stubb's steel, with one flat side facing the work. The lock-pin and the piece *C* were both hardened. *G* is a bracket of sheet steel cut out and bent in the way shown and held by screws *I I*; *F* is the knockout pin, *H* the spiral spring, and this completed the jig. The plate, Fig. 3, was screwed on and the jig strapped to the drill table. The work, Fig. 1, was dropped in place, also the piece *C*, and the lock-pin *D* was given a tap, which held the work fast. The hole was drilled, the lock-pin removed, and the knockout hit sharply with a hammer, causing the work and piece *E* to come out without any trouble, the spring *H* bringing the knockout back in position.

One thing necessary was to have the hole *E* in the casting and the hole in the bushing exactly the same size as the drill; also the drill ground central, thereby leaving only a very slight burr, as, had it been otherwise, it would have caused trouble in removing the work.

Mechanics and Natural History.

"And now, my young friend," said the professor of Applied Natural History, as he wiped off four or five square inches of one of his great spectacle lenses, "we come to a new and most interesting branch of the study of natural history—its application to the broad domain of practical constructive mechanics.

"I purpose showing you to-day, in part, how the various members of the animal kingdom contribute their share, often important, always interesting and useful, in the economy of practical science; and how in their humble way they have been developed—sometimes through long centuries, sometimes by rapid steps—to a condition which permits of their application as active or as passive assistants to the mechanism or the constructor.

"We will first consider the vertebrates, as our nearest relations in the animal kingdom, and see what useful part they play. The noble horse, once the swift courser of the desert, has been, after successive stages of ordinary, slow burden bearing, evolved into a stationary support for heavy masses, such as boilers and the like. His half-brother, the once much despised mule (of whom it has been contemptuously said that he has no pride of ancestry and no hope of posterity), has he not developed, under favorable circumstances and in proper surroundings, a degree of intelligence and dexterity which permits him to perform, unaided and in greater perfection, the textile tasks of many skilled spinning women? The once combative ram, first in the zodiacal procession—he of the hard head and great power of propulsion—now patiently drives huge piles for our great wharves, or, snuffing the scent of battle, places himself at the prow of our mammoth warships and crushes the stout sides of the opposing vessels. The faithful dog, too—man's best friend among the quadrupeds—does he not serve to hold in his teeth irregular metal articles which are to be turned in the lathe? And the pig—of his fat body do we not mold great machines? The bull, which as an entity confines his usefulness principally to furnishing meat for our table and leather for our footgear, lends us his great eyes, through which we reeve ropes. The agile and prehensile monkey has forsaken the forest glades and the lianas of his native land and entered our service as a general 'handy man' to wrench off tight nuts, set up bolts, drive nails and be of use generally.

"Do we consider the volatile division of the animal kingdom—here we find the crane standing patiently on wharves or at railway sidings and lifting for us great burdens, while moving them at our command from place to place. The chivalrous and versatile cock, forsaking his dunghill, not only controls the flow of water and other fluids, but serves to discharge for us our guns. The crow, no less willing than his cousin, the crane, although in lesser degree powerful, raises weights at our bidding, while the gentle cooing dove lends her tail to bind box-corners firmly together. And the bat—he of mixed relationship and nocturnal propensities—his humble body serves as building material for our shops and chimneys. The awkward and long-lived goose—she who once saved Rome by her cackling—contributes her awkward neck to the hydraulician, while the machinist employs it as well as a tool for turning down materials in the lathe.

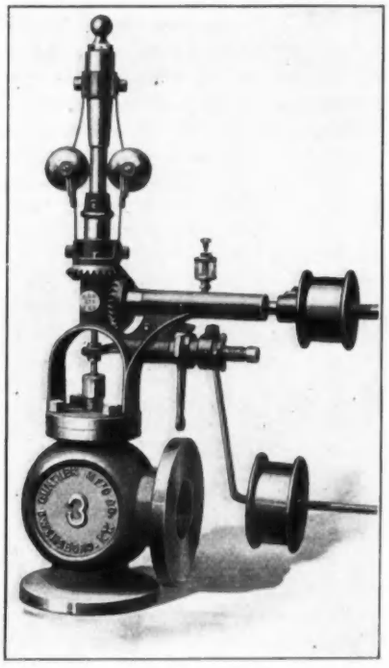
"As we descend in the scale we discover that the lurking alligator, now tamed in the service of his fellow-vertebrate man, grips gas pipe like grim death. And the 'slow but sure' turtle has become the indispensable assistant of the daily newspaper, in carrying upon his broad back the characters which the lightning perfecting press gives to the wide world to inform each of its inhabitants of the comings and goings and doings of all the others.

"When we consider the other cold-blooded inhabitants of the watery kingdom, we find the fish binding together the ends of the rails on our great steel highways; while the herring bone is adopted as the best construction for toothed gearings—showing how Nature anticipated proud Man.

"We can scarcely investigate a group of the animal creation that we do not find its members humbly serving us in some useful mechanical capacity. The grasshopper once lent his huge, awkward, jointed limbs to the construction of locomotives; the obstinate and persevering beetle still drives wedges for us into the hardest oak, while the butterfly—although ever maligned by the poets as the fittest type of frivolousness and irresponsibility and uselessness—has long served to control the flow of gases and even of steam in their proper channels. The fly delivers the printed sheets from the press as fast as they are ready, while her mortal enemy, the spider, serves as an integral radiate part of the engine that drives the machines. And even the despised, down-trodden worm—emblem of insignificance and humility—exerts her poor power in driving gearing; so that from the highest down to the lowest rank, the animal kingdom is serving us daily, unheeded and unthanked."

A Throttling Governor with Automatic Safety Stop.

There is nothing new in principle in the throttling governor here shown, but in details of design and construction it is not undeserving of attention. The valve, which is of the usual type, is, of course, normally open, and is closed, wholly or partially, by a downward movement of the rod imparted by the action of the balls. The speed may be varied by means of an adjustable horizontal spring, which acts endwise and gives a lifting pressure to a forked lever, or, as the makers prefer to call it, trigger, which acts against a collar on the valve stem just above the stuffing box. The sawyer's lever acts directly upon the trigger, thus giving a positive motion. The automatic stop arrangement permits a great range of angularity for the driving belt. It is adjusted by a clamp collar attached to a revolving eccentric, which acts directly



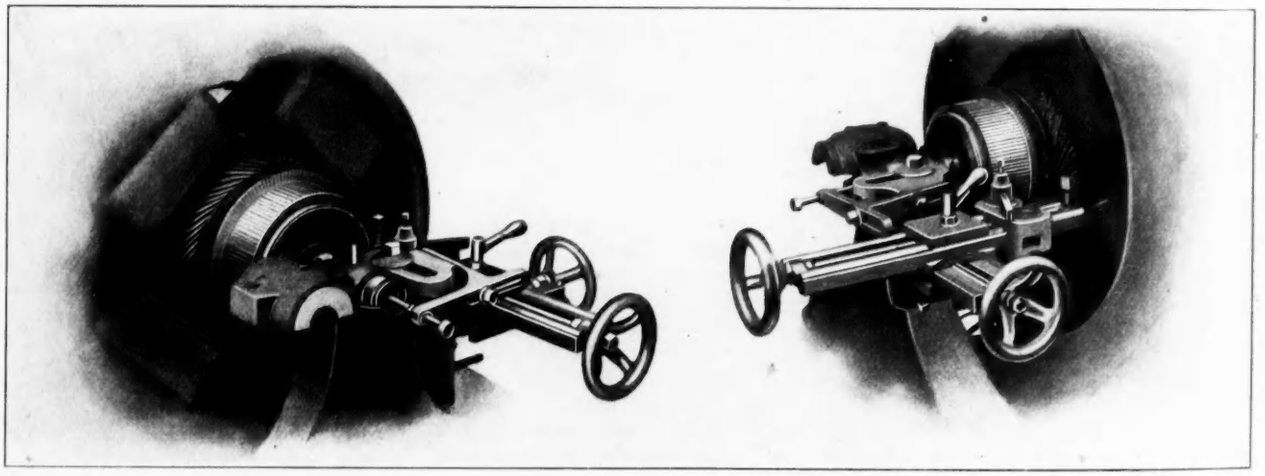
A THROTTLING GOVERNOR WITH AUTOMATIC SAFETY STOP.

upon the valve trigger. In case the governor belt breaks, the idler pulley is heavy enough to turn the eccentric and close the valve. The miter gears are cut. The pulley shaft extends through the gear with a bearing on the inner end. The shaft bearing is unusually long and babbitted the entire length. The offset hub on the pulley allows it to be reversed on the shaft to hang in over the bearing if required, thus giving a wide range of belt location. The pins which carry the governor balls are fast in the levers, the movement being on the center of the ball itself, and the bearing length of the pin extending the entire diameter of the ball. The governor is made in various sizes by Harry Guenther & Bro., Owensboro, Ky.

Commutator Truing Device.

The accompanying illustrations show a device for truing electrical generator commutators in place and without removing the armature from its machine. The illustrations are almost self-explanatory, but it may be worth while to remark that the device is attached to the machine by removing the bearing cap next the commutator in the manner clearly shown. Steadying screws are also provided to bear against the generator frame in order to avoid chatter, and a center screw enters the center of the shaft and stops the end play while the work is being done.

The device is the product of the Akron Electrical Manufacturing Company, Akron, Ohio.



A COMMUTATOR TRUING DEVICE.

Securing the Alignment of Fitted Castings.

The accompanying sketches, Figs. 1 and 2, show the interesting means adopted for securing the alignment of the platens with the beds of large boring machines, as built by Beaman & Smith, Providence, R. I. When these machines are shipped they are so large that they must necessarily be taken apart, and it is very necessary that they go together again correctly, which result is secured by the means shown. Each face is planed flat, and then in each

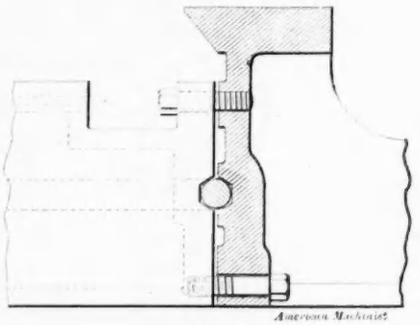


Fig. 1

INSTEAD OF TONGUE AND GROOVE.

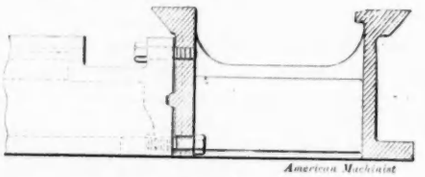


Fig. 2

MODE OF SECURING ALIGNMENT.

is planed also a semi-hexagon groove, and when the pieces are bolted together, short pieces, say a foot in length, of rolled shafting are placed in the grooves and pinched by the tightening of the bolts. The short pieces are nearly end to end and nearly fill the entire length of the grooves, being more convenient for insertion or removal, and not being subject to kinks or springing as might occur with full-length pieces. A dowel, not shown, is provided to prevent any endwise shifting of bed or platen. The leveling of the bed and platen lengthwise of the platen is accomplished by care in setting on the foundation, which would be necessary even if the two pieces were cast together.

Fig. 2 shows the arrangement adopted for smaller machines. The key here forms a part of the bed, and a corresponding groove is planed in the platen. Both key and groove are planed with fitted tools which give the exact circular bearing and the necessary clearance.

An Employees' Elevator.

The hod elevator is a very important labor-saving factor in the erection of modern buildings, and a new application of it, slightly modified, is coming into permanent use in shops and factories. In the great flour mills and grain warehouses of the West a continuously running employees' elevator has been in use for several years. No description of the arrangement is required. There is a vertical endless chain running at suitable speed, and at convenient intervals there are steps and handles. If anyone wants to go up, he steps on, without waiting to call an elevator, and if he wants to go down, he steps on the other side. The time-saving character of the arrangement is self-evident. That there would be no possibility of accident we cannot assert.

Welding Rails by Aluminum.

Some attention has been directed of late to the services which aluminum may render in metallurgy through the large quantity of heat which it produces in taking up oxygen from an oxide. This principle, according to "La Revue Technique," has been applied by Dr. Goldsmith to the welding of electric railway rails, in order to obtain a good electrical connection. The ends of the rails are adjusted and pressed together in a sort of crucible containing aluminum and iron ore, and the charge is ignited. The heat produced is sufficient to make an excellent weld, especially since the expansion of the rails, due to the heat, causes the ends to press together forcibly.

Hawaii as a Source of Supply and Demand.

During the year 1899 the total value of importations into Hawaii was placed at $19,059,605, of which $15,020,830 was im-

ported from the United States, Great Britain coming second with $1,774,655. Out of the total exportation for the year, amounting in value to $22,628,741, as much as $22,517,758 came to the United States. Among the imports only five items of any note show a decrease from those for the preceding year. The items of special interest include guns, gun materials and powder, to the value of $48,272, an increase of $20,738 over the year 1898; hardware, agricultural implements and tools, $940,577, an increase over the year previous of $449,017; machinery, an increase from $1,230,148 in 1898 to $2,089,278 during 1899. A. F. T.

Legal Notes—Improper Statement of Counsel—Employers are not Insurers—Accident in Ice Conveyor—Uninspected Derrick.

BY WM. MARSTON SEABURY.

IMPROPER STATEMENT OF COUNSEL AS TO INSURED LIABILITY OF EMPLOYER.

An interesting case has arisen in Georgia, in which the subject of insurance on the part of employers of the liability which they may incur by injury to their workmen as a result of the employers' negligence is involved.

E. J. Pruitt, a child thirteen years of age, received injuries while in the employ of the O'Neill Manufacturing Company, for which injuries he brought suit to recover damages by his next friend in the Superior Court in Floyd county, Georgia.

The plaintiff testified that it was necessary for him to have a certain kind of a board in order to do the work assigned to him, and that when he mentioned this fact to the foreman he was instructed to make the board he asked for. The only machine on which he could make this was a dangerous machine called a "jointer," as to the dangerous character of which he had never received any warning from the foreman, nor from anyone else. In attempting to make the board his hand slipped, and four fingers and part of his thumb were cut off. The jury rendered a verdict of $1,800 in the plaintiff's favor, and from the judgment the defendant appealed.

While the plaintiff's attorney was addressing the jury he stated that should they render a verdict against the defendant the defendant would not have to pay it, as the defendant had an arrangement with an insurance company whereby the insurance company was bound to pay all judgments of this kind recovered against the defendant. The trial judge severely reprimanded the plaintiff's attorney for this statement, and instructed the jury that they must disregard it, as there was no evidence before the court upon which they would have a right to consider this statement. The defendant relied upon this error of the plaintiff's attorney as its chief ground of appeal, but the appellate court held that as the judge had done all in his power to counteract the statement of counsel and had not committed any error, and since the defendant made no move for a mistrial before the verdict of the jury was rendered against it, the defendant was not entitled to a new trial, but that if the defendant, as soon as this statement was made, had requested the lower court to grant a mistrial for the reason mentioned, the lower court should have granted the request. (36 S. E. R., 59.)

EMPLOYERS ARE NOT INSURERS.

The Supreme Court of Pennsylvania has recently rendered its decision in the case of Service vs. Shoneman.

Some years ago Louis Shoneman, who was a merchant, employed Thomas Service to act as porter in his establishment and as general assistant. On one occasion an engineer by the name of Rubner, who was in charge of Shoneman's boiler, asked Service to hand him a wrench. The two men were standing near the boiler, and the engineer took the wrench to tighten a nut which held one of the plates of the boiler which showed signs of leaking. The result of the engineer's operations was that instead of tightening the plate and stopping the leak, the plate was moved so that it uncovered to some extent the chamber in which the steam and water were confined, thereby allowing a heavy emission of steam and water. The engineer was injured by this stream and Service was thrown into a pit in front of the boiler and so badly hurt that he soon died of his injuries.

To recover damages for her husband's death Mary Service, wife of the deceased, brought action against Louis Shoneman.

The jury in the trial court rendered a verdict in her favor of $5,000, and from the judgment the defendant appealed. The Supreme Court reversed the judgment, and in writing the opinion of the court Mr. Justice Dean said: "We have most carefully considered the evidence in all its bearings and the law that applies to it, and have concluded that to permit the judgment under the undisputed or established facts to stand would fix a precedent practically imposing on the employer the responsibility of an insurer of his employees against accident. . . . 'Absolute safety is unattainable, and employers are not insurers. They are liable for the consequences, not of danger, but of negligence; and the unbending test of negligence in methods, machinery and appliances is the ordinary usage of the business. No man is held by law to a higher degree of skill than the fair average of his profession or trade, and the standard of due care is the conduct of the average prudent man.'"

ACCIDENT IN ICE CONVEYOR.

Walter A. Whitney was employed by the Queen City Ice Company as manager, and as such superintended the storage of ice in a building used by the company for that purpose. While thus employed he received injuries resulting from the alleged negligence of the ice company and brought suit to recover damages. The storage building was about 180 feet in length. At one end of the building blocks of ice were carried on an incline to the upper portion of the house, where they were switched off on to a conveyor which ran through the center of the building and extended from one end to the other. As the ice came upon the conveyor it was moved along by lags, which were fastened at either end by an endless chain at intervals of 6 feet, the lags being about 4 inches square. The chain which secured the ends of the lags passed over a sprocket wheel, which was set in motion by the revolution of a shaft in the tower above, from which shaft a chain came down to the sprocket which engaged the chain upon the moving lags. While the plaintiff was engaged in attending to this work he went upon the conveyor, and, slipping through between the slats over which the conveyor ran, his leg came in contact with one of the lags and was drawn along until it came in contact with a crosspiece, when it was broken and the conveyor stopped. The New York Supreme Court in Chautauqua county, where the case was first tried, rendered judgment for the plaintiff, from which the defendant appealed. The Appellate Division in the Fourth Department, Justice McLennan dissenting, held that as it had been established that the clutch which operated and controlled the conveyor was worn and defective, of which fact the president of the defendant company was notified, and that if it had been in proper condition the injury could have been averted, the verdict of the jury should not be disturbed. (49 App. Div., 485.)

UNINSPECTED DERRICK.

Isaac F. Scandell recently received a decision in his favor from the Appellate Division of the New York Supreme Court, Second Department, in the case brought by him against the Columbia Construction Company to recover damages for injuries sustained while employed by this company.

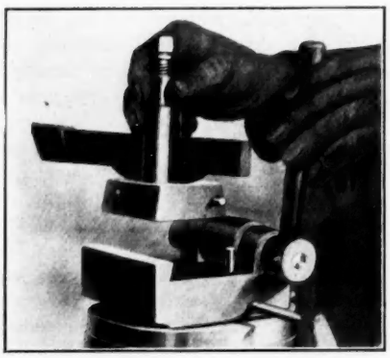
Scandell was engaged in unloading a vessel laden with asphalt, which was lifted out of the vessel by means of a derrick which was operated by steam power. The plaintiff was the driver of a cart in which the asphalt was removed from the ship, and as he was reaching out to catch the bucket of asphalt as it swung around, the boom gave way and fell, striking plaintiff and inflicting the injuries complained of. After the accident the iron band which went over the pin and which held the iron plate resting upon the spar, was found to be raised above the pin. There was also a broken eyebolt in the throat of the boom.

The evidence tended to show that the hole in the plate was somewhat enlarged, which permitted the pin to wabble when it should have been immovable, and it appeared that the defendant employed no one to examine and repair the derrick, and that this derrick had been used over two

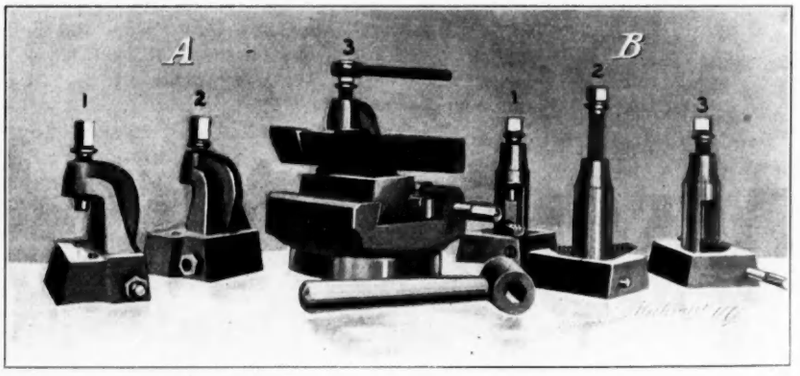
years without inspection. The trial court dismissed the plaintiff's complaint at the close of the evidence, being of the opinion that the plaintiff had failed to make out a case. The plaintiff appealed, and the Appellate Court reversed the judgment and ordered a new trial. (98 N. Y. St. R., 232.)

Exchangeable Tool Posts.

The half-tones show a novelty in tool-posts, the advantages which are claimed for it being principally in the facility provided for the use of successive tools for repetitive work, and especially for work turned upon the lathe centers. The idea is to have a number of tool-posts each holding a separate tool securely, which tools have been set for their respective cuts upon the first of a number of similar pieces to be turned, and then to quickly, easily, accurately and firmly set one in place of another for successive cuts or operations, as is done with tools mounted in a revolving turret. Fig. 1 shows one of the tool-holders being inserted by the operator. It is dropped flat upon the bearing surface indicated and against the beveled side, and is then slid back until the short, projecting, horizontal pin touches the vertical pin, when the hand lever is thrown over and a cam is swung down which clamps the base of the tool-post. The holder may be put upon any lathe which has a compound rest, and in place of the upper part of the compound rest. Another stop is provided, as seen at the lower right-hand corner, for use when it is necessary to move the holder outward to clear the work when inserting the tool-post. The stop may be swung to the side to clear the pin and let the holder move back as required. Fig. 2 shows the two kinds of tool posts, three of each of which comprise a set, although more may be furnished if required. The tools may of course be used for chuck or face-plate work as well as for work on the centers. This is known as the Bayldon interchangeable tool-post system, and is made by the Bayldon Machine & Tool Company, Morris street, Jersey City, N. J.



INSERTING A TOOL POST.



INTERCHANGEABLE TOOL POSTS.

Explosions and Ignitions in Air-Compressors and Receivers.*

BY ALFRED GEORGE WHITE, M. INST. C. E.

The attention of engineers in this and other countries has from time to time been drawn to the results of explosions which have occurred in air compressors and receivers. In some cases the cause has been ascertained, but, as far as the author is aware, no systematic investigation of the subject has been made with a view to obviate the disastrous results of explosions and ignitions, which the author believes to be more frequent than is generally known. The following account of a recent occurrence of this nature which came under the author's notice, with a description of the compressor, may help to throw light upon the subject.

The air compressor was employed for the purpose of supplying air to rock-drills and hoisting-engines in a copper mine in Norway. The usual working pressure being between 50 and 60 pounds, the safety valve of the receiver was loaded to blow off at the latter pressure. It had been continuously at work for seventeen years, and was of English make, with two horizontal air cylinders, 24 inches diameter and 36 inches stroke. The motive power was supplied by a high-speed turbine on a horizontal shaft, upon which a pinion was keyed, gearing with a spur wheel on the compressor driving shaft. On this shaft also there were keyed a heavy flywheel and two crank disks, which worked the air-cylinder pistons by means of connecting rods in the usual way. The inlet valves were plain circular valves with stems, four being placed in each cover of the air cylinders. Bell crank levers fitted with counterweights were attached to the valve stems for closing the valves at the end of each stroke before compression commenced, the atmospheric pressure opening them simultaneously during the inward or inspiration stroke. The outlet valves were of the ball type, of solid brass, fitted in brass seats, two on each delivery port on the top of the cylinders, their action being regulated by the pressure of air in the cylinders and receiver.

The cooling arrangements consisted of an open water jacket round each cylinder, the water supply being admitted near the surface on one side and discharged through an overflow pipe, of ¾-inch bore, on the other side at the same level. The water surrounded the cylinders and air-delivery ports, and stood about an inch deep over the latter. The water supply and discharge being placed at the same level near the top, the water simply flowed over the surface, and did not circulate around the cylinder. It will thus be seen how imperfect the cooling action was in this instance.

The oil used in lubricating the air cylinders was composed of crude fish oil and tallow mixed together, and was put into the cylinders through the inlet valves by a common oil can. The lubrication therefore depended entirely on the attention and skill of the attendant, and no doubt at times a greater or less quantity of oil was poured into the cylinders than was required, and any surplus was driven out through the delivery valves into the air pipes and receiver.

The air receiver, placed inside the compressor house, consisted of a wrought-iron cylinder about 20 feet long by 4 feet 6 inches in diameter, and was connected to the air cylinders by an 8-inch cast-iron pipe. This pipe had an ordinary spigot and socket joint on the horizontal portion between the receiver and compressor. The joint was made of lead run in and caulked, but owing to the contraction and expansion of the pipe it leaked, and had to be renewed from time to time. On the day of the ignition, and shortly before its occurrence, this joint had been renewed by running in molten lead against a hempen gasket, and very soon after the compressor was started flames suddenly blew out in great volume from the safety valve on the air receiver. The attendant succeeded in stopping the compressor within a few moments, but the flames continued for some time and set fire to the compressor house, which was built of timber, and in the course of half an hour it was burnt to the ground.

The author considers the cause which led to the fire breaking out in the receiver to have been the ignition of the oil ac-

*From proceedings of the Institution of Civil Engineers.

cumulated there, and the use of molten lead in making the spigot joint of the pipe referred to, by which the oil must have been first ignited in the pipe. On starting the compressor, the draft of air created would cause the ignited oil in the pipe to set fire to the oil in the receiver, or the fire may have already spread to the receiver. The products of the decomposition of the large quantity of oil in the receiver would, in conjunction with the air, form an explosive mixture, which, failing relief through the safety valve, might have resulted in an explosion. The cause of all explosions and ignitions of this nature can be traced to these phenomena. The case which occurred at the Westphalia Colliery in 1896 resulted in destruction of the air receiver by bursting. In the present instance the rise of pressure does not appear to have been sudden enough to burst the receiver, and the relief afforded by the safety valve averted this catastrophe. When the receiver was opened it was found to contain a quantity of charred oil in the form of a sticky paste about 2 inches deep in the bottom. The air pipes were coated inside with a similar substance. The damage done to the compressor and receiver was, however, considerable, the riveted joints of the latter being started and the lead joints of the contiguous pipes and connections melted out. One cylinder of the compressor and one crank disk were cracked, as also were two arms of the turbine, which was placed inside the house burnt down. The latter effects were chiefly due to the subsequent fire and the water which was thrown upon the heated metal.

The primary cause of this fire was the accidental ignition of the oil by the admission of molten lead into the pipe referred to, but the same effect may be produced by an increase of air pressure, and consequently of temperature, to a point at which the decomposition of the oil and ignition of the air and gas mixture take place, or by the admission of coal dust or inflammable matter into the valves or cylinders of the compressor. The use of oils possessing low flashing temperatures, and the increase of temperature from friction of metallic surfaces improperly lubricated, are also elements of danger, besides defective water-jacketing and cooling arrangements.

The temperature of air when compressed adiabatically to 58.8 pounds per square inch gage pressure from 60 degrees Fahr. initial temperature is 270 degrees Fahr. The air admitted to a compressor is, however, sometimes at a much higher temperature than 60 degrees Fahr., and may in some instances be as high as 100 degrees Fahr.; the temperature of this air when compressed to 58.8 pounds per square inch gage pressure will rise to about 430 degrees Fahr., and when compressed to 75 pounds per square inch the final temperature is nearly 500 degrees Fahr. This shows the importance of (1) a low initial air-temperature; (2) adequate cooling of the air before or during compression; and (3) the use of lubricating oils of high flashing and ignition points.

A similar ignition to the one mentioned by the author occurred in 1897 in the Clifton Colliery air receiver, and tests were made of the oil then in use, giving the following results:

—	Flashing Point. Close Test.	Ignition Point.
	°F.	°F.
Sample No. 1	454	594
Sample No. 2	460	588

Lubricating oils of high-class manufacture, distilled from petroleum and used for high-pressure steam engines, give flashing points of 530 to 560 degrees Fahr. (open test), and ignition points of 600 to 630 degrees Fahr. It is, however, sometimes the case that oils having a high flashing point are mixed with others having a much lower one, and therefore a guarantee should be demanded or a test of the oil should be made. The flashing point of the oil used in the compressor described by the author, taking that of Arctic sperm, would be only 446 degrees Fahr.

It is evident that, given reliable oil of high flashing point and normal conditions of working for a well-designed air compressor, the danger of ignition is practically eliminated, as shown by the following table:

Working Pressure of Air.	Initial Temperature of Air.	Final Temperature of Air Compressed Adiabatically.	High Temperature Oil.	
			Flashing Point.	Ignition Point.
Lbs. per Sq. Inch.	°F.	°F.	°F.	°F.
58.8	60	370	530	600
58·8	100	435	560	630
75·0	100	500		

The final temperature of the air will, of course, be diminished when the air is cooled during compression in proportion to the efficiency of the cooling apparatus, and in hot countries, where the initial temperature of the air is high, the addition of an apparatus for cooling the air prior to admission to the compressor, in addition to other cooling arrangements, would be attended with economical and advantageous results.

With reference to the design of air compressors, the author is of opinion that the following points require special attention: (1) The arrangement of the air admission to the compressor in such a manner that the lowest possible initial temperature is obtained, and the air protected from all dust or inflammable matter and sparks. (2) Efficient water-jacketing of the air cylinders by closed jackets, with water supply under pressure, and, in the case of double-stage compressors, an intermediate cooler of adequate capacity. (3) The more general adoption of compound or double-stage compressors with intermediate coolers, whereby a more effective cooling of the air and greater economy of power are attained. (4) The employment of automatic lubricators on the air cylinders. (5) The use of pyrometers, whereby the temperature of the air in each cylinder and in the receiver can be seen by the attendant. (6) The reduction of clearance at the ends of the cylinders and of the valve ports to a minimum. (6a) The design of valves having definite action, without friction in working, of ample area and readily removable for inspection or cleaning. (7) The use of tested oils having high flashing points. (8) Proper arrangements for draining and blowing off accumulated oil in both air receiver and pipes.

About two years previous to the ignition described by the author an explosion occurred in one of the cylinders of the same compressor, resulting in destruction of the cylinder. The cause of this was not ascertained at the time, but it was probably due either to excessive friction in the cylinder or defective action of the valves, causing an increase of temperature and consequent decomposition of the oil, or to an increase in the air pressure sufficient to burst the cylinder.

The production of fire by means of the sudden compression of air is known to the aborigines of the Philippine Islands, who employ a small tube fitted with a plunger which, on being sharply struck, ignites combustible matter placed at the bottom of the tube.

The University of Wisconsin announces a School of Commerce as one of its new features for the coming year. The purpose of the school is to supply facilities for the training of young men who desire to enter business careers, especially in such fields as domestic and foreign commerce and banking, or branches of the public service, like the consular, in which a knowledge of business is essential. The scope of the school is essentially different from and every way larger than that of the familiar "business college." The course of study, which we have not space to enumerate in detail, extends through four years, and a full schedule of professors and lecturers is provided for. Inquiries should be addressed to W. D. Hiestand, registrar, or to William A. Scott, director, Madison, Wisconsin.

In the article on "Progress in the Use of Aluminum," published in No. 28, at page 38, a certain sentence should have read: "It is therefore only necessary to take an aluminum wire *one-fourth* as large again in diameter as a copper wire (giving a little over 50 per cent. more section) to get equal conductivity." It was all right in the copy, but the italicized words were omitted through a printer's error. Mr. Roger Haines, Watertown, N. Y., has called our attention to the mistake.

Letters from Practical Men

Indicators as Applied to Milling Machines.

Editor American Machinist:

While the usefulness of the graduated, multiplying indicator as applied to lathe, planer and testing work, is pretty generally understood, there are still many other operations in all departments of metal manufacture, where, by its use, work can be both facilitated and improved. Having lately experimented with very satisfactory results for the purpose of determining its actual value in a regular line of machine-tool milling, I will try and describe a few operations where it was used to advantage.

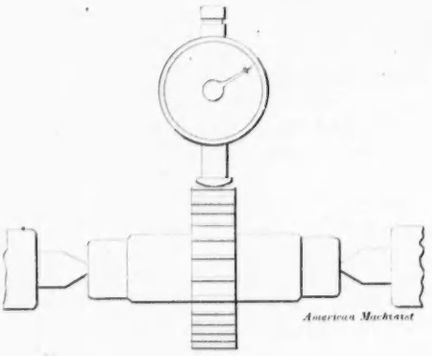


Fig. 1

TESTING CONCENTRICITY OF MILLING CUTTER.

In Fig. 1 a freshly ground cutter is shown mounted on a lathe mandrel (previously tested), in a pair of Pratt & Whitney centers having an indicator attached, to determine if (when revolving) all the teeth are "even" or concentric. This is especially useful when applied to machine-relieved cutters. Fig. 2 shows a rig for holding the indicator while truing a cutter when both cutter and arbor are in place on the machine.

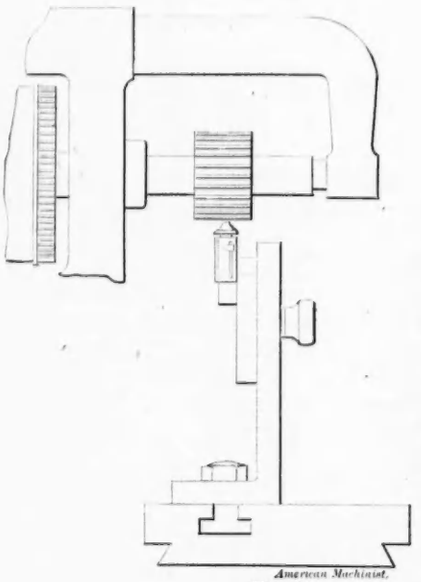


Fig. 2

RIG FOR HOLDING INDICATOR.

Arbors are ground from .003 to .005 inch smaller than the sizes of standard holes in cutters to permit the shifting of the cutters when truing. Indicators having flat shanks or stems are most convenient when they are used only occasionally, or on different machines, as they then can be readily clamped to fixture, work or table, and in many positions. When they can be suspended from overhanging arm, as in Fig. 5, or column, those with round shanks or stems are best.

Fig. 3 shows how single or double-ended facing and boring cutters in boring-bar are tested, both for diameter of hole to be bored and for truth, displacing the old cut-and-try method by one absolutely certain.

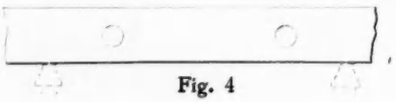


Fig. 4

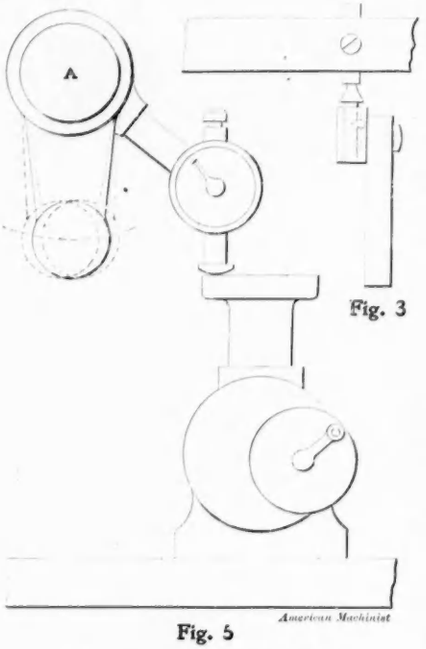


Fig. 3

Fig. 5

DIFFERENT USES OF INDICATOR.

Alignment of bar with cross-slide is secured as shown in Fig. 4, by turning over arm on its axis, as shown (exaggerated) by dotted lines at *B*, Fig. 5. Fig. 5 shows how the depth of slots or grooves in repetition work, such as clutches, bevel gears and keyways, may be quickly gaged without "touching" each piece with the cutter. This is also useful in setting center line of head and tail-stock (when vertical adjustment is provided) parallel with travel of table horizontally, and laterally, if table swivels.

Anticipating objections which may be made to having arbors smaller than holes in cutters on account of shifting, I will say that we, with a 4-pitch gear cutter having a hole .01 inch larger than arbor, milled 50 inches of steel ½ inch deep at a speed of 37 feet per minute and .098-inch table feed per revolution, and again, 15 inches ½ inch deep at a speed of 41 feet and .150 inch feed per revolution without shifting cutter; also, the arbor was not splined. This forces the conclusion that when arbor collars are properly proportioned and in good condition they will not slip unless abused or overloaded, also that keyways, for the most part, are unnecessary. Cutters properly ground, running true, with every tooth doing its proper share of work, last longer, do better work, and can be crowded harder than when any of these essentials are missing. I almost neglected to state that in truing we established a limit of error of .002 inch, though .001 inch is easily attainable.

A. B. CHRISTMAN.

Cutting and Drawing Die for Paper Box Covers.

Editor American Machinist:

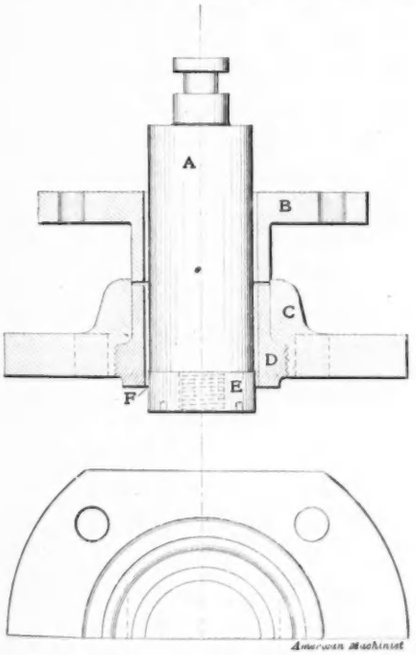
The sketch shows a die for making paper-box covers. While it appears to be a common double-action die, it has some new features. This die was made by the writer in 1887, and we have seen nothing to surpass it up to this date. The die as shown is for making, at one stroke of the press, a cover 2¾ inches diameter with an edge or rim nearly 5-16 inch deep. These covers are used for cartoon cases and many other purposes. Many sizes and shapes have been made in similar tools.

The cuts need very little explanation, as they show the die very plainly. They are made of iron and steel forgings, instead of steel rings set into cast-iron holders. The drawing plunger *A* has a hardened tool-steel point on it, which is detachable and can be removed easily when it becomes worn below its proper size. *B* is the cutting punch, which also acts as a blank-holder which serves to keep the paper blank under just the proper pressure, so that it will draw down without folds or laps into the ironing ring *D*. This ring *D* is also made removable, and can be quickly replaced by a new one when it becomes worn. This ironing ring is made as long as possible, and left very hard. It is highly polished, giving it a glass-smooth finish inside, with a taper of 1-1000 inch on a side towards the bottom. This is done so that the paper will be tightly compressed as it passes through this ring, thereby retaining its shape. Two sides of this ring are flattened on the lower part, so that a wrench can be used to screw it tightly into the cutting die *C*. A very important feature of this ironing ring is its lower corner, marked *F*. This must be kept very sharp, as it is the stripping edge for the drawing plunger. This edge is usually left a trifle long, and projects beyond the die proper to allow for sharpening as often as it becomes worn.

In many cases these dies are steam heated, which greatly assists in the drying of covers while passing through them; but of late years most of them are worked

without heat. We feel, however, that much better work is done in the heated dies. The dies are made the same whether used with heat or without, the difference being only in the bed-plate upon which the dies are fastened. When steam heat is used this plate is cored out inside, so that steam passes through it. The ordinary gages and strippers are used, which we have not attempted to show in the cut, as various devices can be applied for this purpose.

One of the principal things about paper drawing is its preparation. Of course, good stock must be used, but even the best must be prepared for the drawing operations. A good preparation is here given: Use the mineral wax called "Ozokorite"; when refined it looks like paraffine. Take 3 ounces of pure mutton tallow to each pound of "Ozokorite"; boil together and



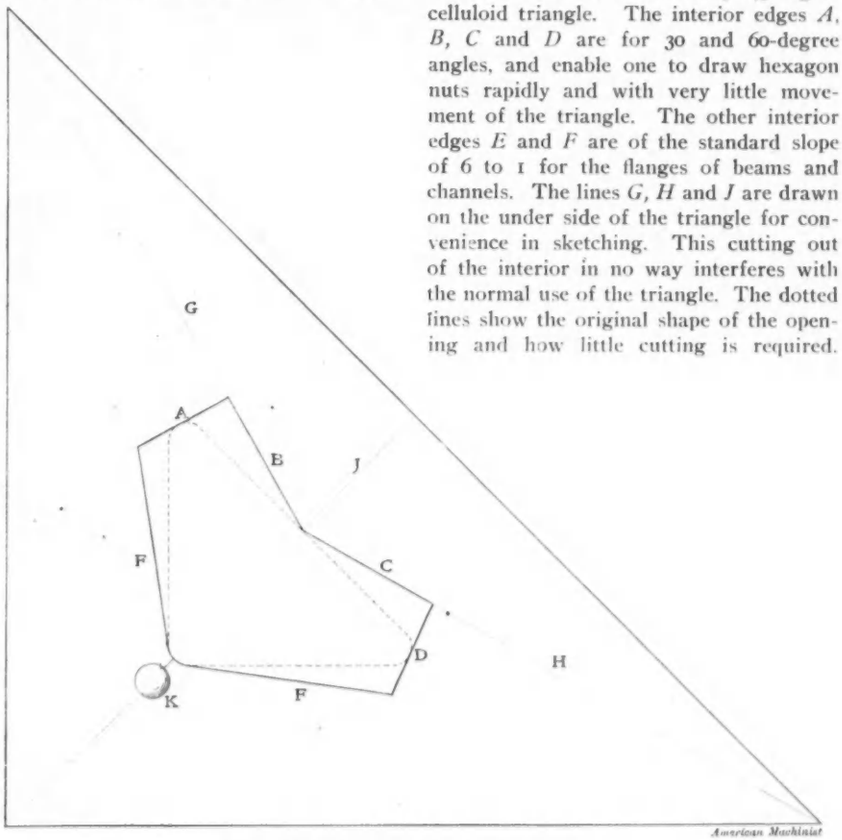
CUTTING, DRAWING AND FORMING DIE FOR PAPER BOX COVERS.

mix well; use when cold. Form it into convenient cakes, so that it can be easily handled. Rub this on to one side of the cardboard only. (No harm is done, however, if both sides of the paper are coated with it.) The black "Ozokorite" is not considered as good as the refined. Paraffine is often used, with very good success—even a strong solution of soapsuds will do to moisten the paper, but this must be used on both sides, and care must be exercised and the paper must not be too wet.

The following course is generally pursued: First, cut the large sheets of cardboard into strips, just wide enough to cut out two rows of covers. This makes it very convenient for rapid handling. Take these strips and moisten one side of each with clean cold water, applying it with a brush or a sponge, laying two moistened sides alternately together. This should be done the evening before the paper is to be used. In the morning, before using these strips, rub the dry side of the paper with the cake of "Ozokorite," and then the paper is ready for the press. Place the moist-side up, facing the cutting and drawing punches, and the side with the "Ozokorite" down on the die, then proceed with the work of cutting the covers.

A little experience is required to successfully prepare the paper, as different stock requires different treatment. After carefully watching results, one soon gets the right knack of doing it every time. A good press and well made dies are of course most essential, as well as good stock. This system is in use in a mill where from 15,000 to 20,000 cartoon covers are made daily in single dies. Sometimes presses are fitted up to cut from two to six covers or bottoms at each stroke, according to the size of the article and the strength of the machine. It is possible that many modifications and improvements may have been made along this line, but as we have never seen or read of any, we have concluded that it may be of interest to your readers. CANDOR.

Down East.



A HANDY TRIANGLE FOR THE DRAFTSMAN.

Another Triangle.

Editor American Machinist:

Several of your correspondents have described draftsmen's triangles of more or less novel construction. I have had one in use for a long time, which differs from any described, and which I believe to be superior to most of them for practical use. As a rule, I am opposed to combination tools, and avoid them as I would avoid combination furniture, even if living in a Harlem flat. To me there is something absurd in the idea of triangles, scales, protractor, erasing stencil, irregular curves, etc., combined in a single tool. They always remind me of a combination hammer, screwdriver, saw, glass-cutter, ice-pick and I don't remember what else, that once came into my possession—the most useless piece of metal imaginable.

However, the accompanying sketch shows a *multum in parvo* that is all right. It is made from an ordinary 45-degree celluloid triangle. The interior edges *A*, *B*, *C* and *D* are for 30 and 60-degree angles, and enable one to draw hexagon nuts rapidly and with very little movement of the triangle. The other interior edges *E* and *F* are of the standard slope of 6 to 1 for the flanges of beams and channels. The lines *G*, *H* and *J* are drawn on the under side of the triangle for convenience in sketching. This cutting out of the interior in no way interferes with the normal use of the triangle. The dotted lines show the original shape of the opening and how little cutting is required. *K* is a handle, about 5/8 inch high, with a spherical top about 3/8 inch in diameter, tapped into the body of the triangle and slightly upset. With this triangle it is surprising how seldom one will use the regular one of 30 and 60 degrees. If a draftsman becomes used to a triangle with a handle he will never use one that is not so fitted, unless it is necessary. By means of the handle the triangle is easily picked up and rapidly moved to any desired position. Moreover, the handle prevents turning over and avoids soiling the drawing from the dust, ink, perspiration, etc., that are unavoidable on the top side. Many draftsmen have seen and tried this triangle. All agree that it is exceedingly convenient, and some have adopted the scheme immediately. Mark both sides accurately with a steel scriber, cut with a sharp knife and finish with a fine file. The handle of mine originally did service in a

nickel-plated hot-air register, and I could not design a better one for the purpose.

FRED B. COREY.

A Fixture for Slotting Studs.

Editor American Machinist:

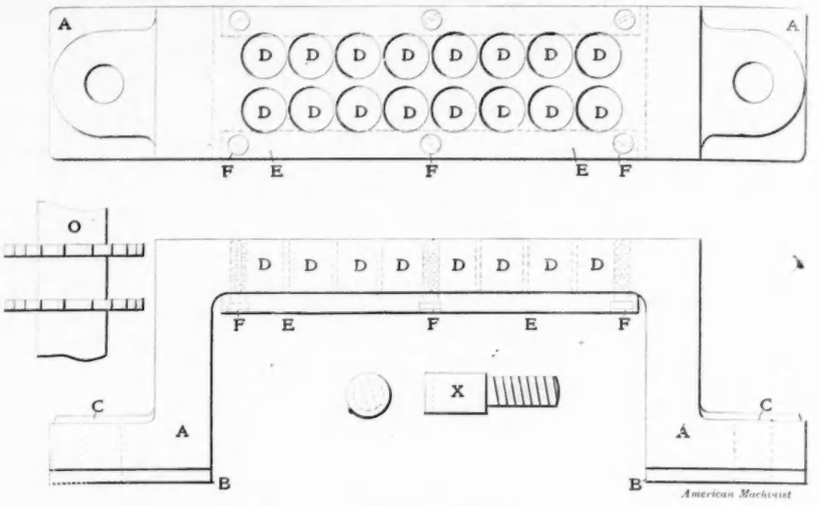
At our place there was recently made and used a fixture for slotting studs which seems worth knowing, not less for its simplicity and cheapness than for its departure from the usual practice in such work. There were not a few predictions made that it "wouldn't work," which failed, however, to interfere with its successful operation.

We frequently have to slot the ends of studs like *X* in lots of from 25 to 200, and we needed a fixture capable of quick manipulation and always in order. The sketch shows how we made it. The casting *A* was planed with a tongue on the bottom to fit the slot in the table of the milling machine, with holes in each foot for bolting it securely. The studs to be slotted were all finished accurately to standard diameters, and holes *D* in the fixture were drilled and reamed .001 inch larger than the studs. These holes went straight through the top. *E E* are two retaining strips of machine steel, fastened by screws *F* and extending a little distance under the edges of the holes *D* to prevent the studs from dropping through. *O* shows a portion of an arbor with cutters spaced the same as the two rows of holes *D*. In setting up, it is only necessary to adjust the cross-slide so that the cutters will pass the centers of the holes, and then vertically for the depth of the slot. In operation, fresh studs are constantly inserted ahead of the cutters, and the finished ones are removed behind, all with the fingers; the only time lost being in running back the table after the entire row is finished. This rig cost about $15.

Perhaps some of those "magicians" who have attained that degree of efficiency in the operation of milling machines that enables them to "feed in either direction in all kinds of work" would consider as unnecessary the returning of the table to the starting point, and would cut both "comin' and goin'."

We have also a fixture differing from this only in that holes *D* are threaded and studs are screwed in and out, also with the fingers; but it is not nearly so convenient, on account of the difficulty of keeping the threads perfectly clean.

A. B. CHRISTMAN.



A FIXTURE FOR SLOTTING STUDS.

How to Mold a Drum.

Editor American Machinist:

Will you tell me, as minutely as you have time, of the best way to mold a hoisting drum like the sketch, Fig. 1, the length *C* to vary in different castings, the ends *A* and *B* of the pattern being turned separately, and each in one piece, not split; *C* to be molded from a pulley-rim pattern and drawn up in the flask as necessary. How would it best be cored, vented and poured? Can a green-sand core be used on larger sizes, say, a foot or more in diameter? Can it be molded in a two-part flask?

NOVICE.

Editor American Machinist:

This is in answer to the enquiry of "Novice," as to how to mold drums with varying length, using a pulley rim for pattern to mold the body, etc. The ends *A* and *B* are often, especially in large sizes, combined in one pattern, the brake ring *E E* being loose. This lessens the pattern-work without perceptibly increasing the cost of molding. All drums should be molded upon the end, and so cast, insuring better results as to balance. Where there are outside flanges, both top and bottom, a three-parted flask seems indispensable. The inside core can be made of green sand, and if the drum is 12 inches, or more, in diameter, and providing the openings in the ends are not less than 1½x3 inches, and not too deep, it is best made of green sand, as, again, it insures a better balanced casting than if dry sand was used. A much less opening than mentioned would mean liability to disaster, as the openings have to serve as stools for the core to stand upon, as well as exits for the vent. When the inside is of dry sand, a ¾x2½-inch opening would answer, or perhaps less.

The inside, if of green sand, must be moderately soft and well barred across to keep the core from cracking. The core being pretty nearly enveloped with hot iron, it follows that steam is rapidly generated, and the steam must be respected, and respect is best shown by introducing a few cinders, and using that portion of sand moderately dry. By punching some prongs down around the skeleton when cast, it will form a basket to secure the core. Such skeletons have to be broken out, a new one being required each time for small drums. For large drums they are made in sections and bolted together.

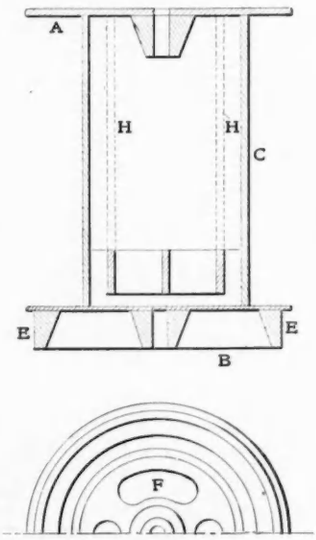


Fig. 1

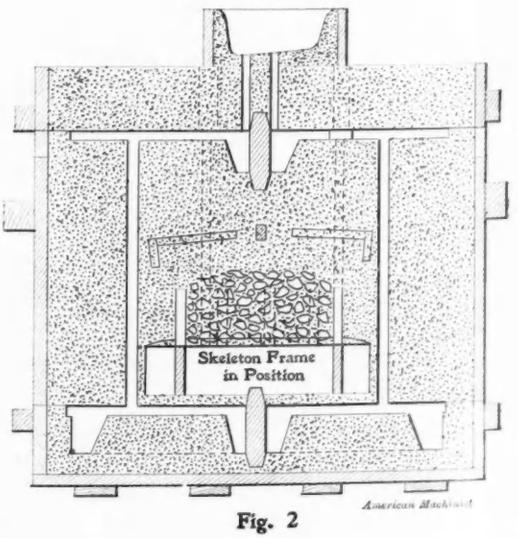


Fig. 2

MOLDING A DRUM.

THE OPERATION.

The part marked *B* should be placed upon a follow-board and the nowel rammed upon or over it; then turn the nowel over. With the cheek made to the depth that the body *C* is required placed upon the nowel, the pattern for the body is also placed upon the pattern *B*, and then rammed up both inside and outside. If the drum is of moderate size, 20 inches or larger in diameter, put in the skeleton ring, and as it is rammed up, vent, and use some cinders. Be sure and have the sand for the inside of quite dry temper. If the core is well ironed acrosswise, the center of the core can be of very dry sand; it will absorb the steam as it is generated, and is nearly as good as cinders.

When the pattern or rim is drawn to the top of the cheek, with both inside and outside rammed up even, put a board, well rubbed, on the top and turn the cheek and nowel over. Remove the nowel, draw out the end pattern B, put the nowel on, and then turn back again. Put the end pattern *B* minus the ring *E E* upon the body pattern, and proceed to bed upon it in the usual way, preparatory to ramming the cope. The above is assuming that there is but one pattern for the ends. When there is a pattern for each, there is no need of removing a part of the flask until all is rammed up. Drums are usually poured in the center upon the cope side with one or two sprues, with a good, deep, commodious runner that can be choked when piece is poured. Fig. 2 is a section of the mold complete.

L. C. JEWETT.

Name Plates on Castings.

Editor American Machinist:

In your issue No. 29 the article with the above title was read with interest, and I venture to add a suggestion in connection. If possible all railroad car castings should have the pattern numbers plainly in sight when in their place on the car, for this simple reason: When cars belonging to "foreign" roads are wrecked they have to be put in good repair before returning to their owners, and it saves expense to take a list of all the broken castings required and send for them to the headquarters of the respective roads. If the various pattern numbers can be found, there should be no trouble in getting what is wanted; but where these have been omitted, or are on hidden surfaces, then often a sketch with measures must be sent.

When a lad, I once went into a foundry just before pouring time and saw the molder going to several flasks, not closed, with something like a branding iron in his hand, with which he stamped the molds. I have thought of that many times since, but have never seen it done but in that one place. I believe it might be used to good advantage in cases where it would give patternmaker and molder extra trouble to make in the core box. One can see that by having separate characters with a suitable holder, similar to rubber stamps, a name or number could be set up at will and used with little trouble.

Oneonta. WM. NEWTON.

Processes of a Typewriter Factory.

Editor American Machinist:

The investigation and interest taken by you in my criticism of the article on type wheels justifies us older readers in recommending to the young people the reading of your journal, it being a periodical that gives, or desires to give, reading matter of value, with no other motive than progress in the arts for the humblest employee as well as the most successful employer.

As Mr. Blickensderfer states that he does "blow out" his wheels with a little water only, and that he intends to do this in the near future by applying high-pressure steam directly to the interior of the mold from the boiler, also that the long cylinders lying on a movable bench are several molds clamped together, it must be admitted that such is the case. However, my own experience may help the reader of the "American Machinist" who desires to "blow out" a type wheel.

I append hereto a slip of paper upon which is typewritten a proof from five wheels made here, printed one upon the other. It will be found upon close inspection that the printing is as clean as if written with one wheel. The alignment is of a superior quality and can only be such from a highly satisfactory wheel.*

After many months of expensive experimenting with a ring matrix having one joint which would be spread apart and then pulled off the vulcanized wheels, it was finally decided to go back to the section molds (which had been tried in the earlier experiments, but laid aside on account of lack of precision in construction), as it was impossible to get the alignment of the characters anywhere near correct where the joint of ring matrix was located. The sectional molds measured, after they were completed, about 5/8 inch more than the wheel itself, and several of them clamped together were not as long as the cylinders, as shown in the Blickensderfer illustration, Fig. 2, within 2 feet, as near as can be judged from the surroundings in said cut, yet gave entire satisfaction. For the "blowing out" of the wheel we found water alone of not sufficient strength to be reliable. We therefore added a chemical which gave the liquid greater expansive power when heated (this addition of chemical is well known to the workers in hard rubber who make "blown" goods). The wheel turned out with sectional mold proved satisfactory in every particular.

In looking back and reviewing our experience, I would say that expense, delay and trouble were mostly caused by lack of precision. All that appertains to the making of a satisfactory type wheel must be made as accurate as human ingenuity can make it. The master-wheel must be positively accurate in every detail, and the flask and requisites for casting the matrix must be constructed with the same accuracy. The rubber composition must be of proper quality. The composition used by those making type wheels similar to the Hammond and Keystone will not prove satisfactory for the hollow wheel, as it seems to lack in the amount of rubber. Presumably this is not necessary in this class of type wheel, or rather type arch, as it is not "blown." As we used the "wet process" for vulcanizing, our molds soon showed the effect of corrosion; therefore long tubes were used in which several molds were placed, the tube being then placed in the water when vulcanizing, keeping the molds dry and lengthening their life.

The hard rubber companies who have tried to produce type wheels and failed, have, in my belief, failed simply because of the lack of precision in the finer details of the work. Their molds seem rough and the wheels are soft; not possessing the strength to resist wear of blows in printing—in fact, they impress one as having been made by hands who could make surgical goods, but who did not seem to understand that an error of .0001 inch in a type wheel makes it useless. More might be said on this subject, but believing that I have said enough for the reader who may desire information, to begin with, I might add: When you get ready to begin, hire a man who has been through the mill. It will save you not only $1,000, but, from experience, I may say possibly $10,000 or more. I believe I have proved to the "American Machinist's" readers that perfect wheels can be made in more than one or two factories in the world, provided the matter is handled with requisite care, and the micrometer by a man who does not have to brace his feet, take hold of the micrometer with both hands, and tear it off his work where he has fastened it in testing size to .0001 inch.

JOHN G. NIEDERER.

*Of course this specimen of work cannot be reproduced, but it is perfect—ED.

An Auxiliary Hand Feed for the Shaping Machine.

Editor American Machinist:

Just a word about Fig. 1, illustrating Geo. J. Meyer's article on "An Auxiliary Hand Feed for the Shaping Machine," in issue No. 28. I've run a shaper a great many times in my life, and on all sorts of odd work, and I can't at this time recollect a single instance when I found it necessary to assume the position of the operator in the illustration. Why, I should like to ask, couldn't he operate the down feed with the left hand and the cross feed with the right? Were he to do this, there would be no danger of his developing into a contortionist, as Mr. Meyer fears.

I am free to admit, even under these

conditions, that there are times when the feed handles are difficult of access, and that his scheme will, in a large measure, overcome these difficulties. Its merits are apparent, without the use of Fig. 1, which shows an unnatural position that none need assume. Perhaps I should add that I am in no way interested in the manufacture of shapers. SACHEM PARKS.

Auburn, R. I.

Screws in Pulley Hubs.

Editor American Machinist:

In a recent issue of the "American Machinist" Mr. E. J. Armstrong described a cure for the loose pulley nuisance, but he did not say a thing about the worse offender of the two—the tight pulley. Every machinist and engineer knows what a delightful thing it is to have a pulley tear itself loose on the shaft and raise a burr around the shaft inside the hub, with a corresponding groove in the hub, making it nearly impossible to sledge it off. This is always sure to occur sometime with pulleys held by set screws. The obvious way to prevent it is to use keys in all tight pulleys. But since nearly all pulleys are fitted with set screws, the only cure for it is to file a seat for each screw with a half-round file, at least 3-16 inch deep in a 2-inch shaft. The filing, being crosswise, makes a seat nearly round. The burr raised by the screw is then below the surface, where it can do no harm. If this is properly done, it is the best substitute for a key, and if it fails then a key is a necessity. C. W. CRAWFORD.

Brazil, Ind.

[In a discussion of this topic in our columns three or four years ago, the consensus of opinion seemed to be that neither screws nor keys were required for pulley hubs, a good fit for shaft and hub, and then the hub split through one side, with bolts for drawing together, making a clamp sufficiently strong and with no possibility of injuring anything.—Ed.]

Table for Spacing Holes in Circles.

Editor American Machinist:

To facilitate the work of machinists in laying out holes for drilling, I have recently prepared a table which I could not find in print. I therefore send you a copy of it for publication, as many a shop man will be glad to see it and preserve it.

The quantities in the column headed *S* are the sines of the half angles obtained by dividing the circle into the number of equal parts given in the column headed *N*. For example, to divide a 62-inch circle into 44 equal parts, find 44 in the table and on the same line under *S* is .071339.

$$62 \times .071339 = 4.423018 \text{ inches}$$

If now, having drawn two diameters at right angles to each other, the dividers are set to 4.42 inches, using for the purpose a scale divided in tenths or hundredths of an inch, the bolt holes can be marked off at once without the usual tedious approximation.

For most purposes in the shop the first three figures will give close enough results, and it is useless to multiply in all five. The table is computed to five places for the convenience of draftsmen or pattern makers when dealing with large work, as flywheel segments, etc.

Such a table will facilitate many operations in the shop and drafting room, and should be incorporated in the handbooks. Will Mr. Kent please note it?

N	S	N	S	N	S	N	S
1		26	.12054	51	.061560	76	.041325
2		27	.11609	52	.060379	77	.040788
3	.86603	28	.11197	53	.059240	78	.040267
4	.70711	29	.10812	54	.058145	79	.039757
5	.58779	30	.10453	55	.057090	80	.039260
6	.50000	31	.10117	56	.056071	81	.038775
7	.43388	32	.098018	57	.055089	82	.038303
8	.38268	33	.095056	58	.054139	83	.037841
9	.34202	34	.092269	59	.053222	84	.037391
10	.30902	35	.089640	60	.052336	85	.036953
11	.28173	36	.087156	61	.051478	86	.036522
12	.25882	37	.084804	62	.050649	87	.036103
13	.23932	38	.082580	63	.049845	88	.035692
14	.22252	39	.080466	64	.049068	89	.035291
15	.20791	40	.078460	65	.048312	90	.034899
16	.19509	41	.076549	66	.047582	91	.034516
17	.18375	42	.074731	67	.046872	92	.034141
18	.17365	43	.072995	68	.046184	93	.033774
19	.16460	44	.071339	69	.045515	94	.033415
20	.15643	45	.069756	70	.044865	95	.033064
21	.14904	46	.068243	71	.044232	96	.032719
22	.14232	47	.066793	72	.043619	97	.032381
23	.13617	48	.065401	73	.043022	98	.032051
24	.13053	49	.064073	74	.042441	99	.031728
25	.12533	50	.062791	75	.041875	100	.031411

To find the length of a chord to divide the circumference of a circle into *N* equal parts, multiply the diameter by *S*.

G. A. H.

Logarithmic Cross-Section Paper.

The simultaneous publication, in your issue No. 25, of Mr. Brown's article on "Logarithmic Cross-Section Paper" and G. A. H.'s note on the "Construction of the curve $P V^n = C$," is a coincidence which has more than an ordinary significance for me.

In the first place, it may interest G. A. H. to learn that the method he describes was shown, as applied to the construction of the adiabatic curve, in the "American Machinist" for June 13, 1895—a fact which, if one may judge from the editorial comment on page 591, had also escaped the notice of the editor himself. This, however, is not to be wondered at, for it is next to impossible to keep track of a tithe of the many good things hidden away in past volumes of the "American Machinist." The German construction (first described in "Zeitschrift des Vereines Deutscher Ingenieure" for 1885, volume xxxi, page 433) is preferable to the construction submitted by Prof. Low; but I think the application of logarithmic section paper to the solution of such problems offers a method superior to either, and as one who has done a little missionary work in this direction, I would recall the fact that I wrote an article describing the uses of logarithmic section paper, showing its application to adiabatic curve construction, and which appeared in the "American Machinist" for August 1, 1895. It is interesting to note the widening use of the paper during the last few years—a result no doubt largely due to the efforts of Prof. W. F. Durand to make the utility of this system of graphic calculation more generally known.*

In this connection, and in view of the revived interest in logarithmic section paper, a few notes as to its earlier history may not be altogether out of place.

The earliest printed reference to logarithmic section paper which I have been able to find is the essay by L. Lalanne, a French engineer, which appeared in 1846.† There is, however, evidence that the paper was known before Lalanne directed attention to it.

The simplest application shown by Lalanne is what is called an "Abacus," and which consisted of a sheet of logarithmic paper across which was ruled a series of diagonal lines forming angles of 45 degrees with the horizontals and verticals of the sheet—similar, in fact, to *A B* and *C D* in Mr. Brown's Fig. 4 (page 584), but sufficiently numerous to connect the terminals of all the horizontal and vertical lines. After showing that such a diagram supplies a graphic multiplication table, Lalanne proceeds to show how it may be used for continued multiplication and division, or for the two operations combined. He then points out that if a line be drawn through the lower left-hand corner, and forming the tangent 2 with the horizontal, then each vertical will cut the horizontal on this line, in its square, and on the inclined line in its cube. In this way *two* lines only are required to give squares, cubes, square roots and cube roots. Further, assuming a whole series of lines of equidistant tangents to be drawn, these will cut any vertical on the horizontal at its 1, 2, 3....*n*th power, and on the inclined line at its 2, 3, 4....$(n+1)$th power. Lalanne then points out that if it is necessary to multiply squares, cubes or other powers by one coefficient, this may be readily effected by means of a pair of dividers; or if the number occurs frequently, by drawing a line parallel to the line of squares, etc., and at a distance vertically above it, equal to the value of the coefficient. This is an important point, and one which I fail to find directly noted in Mr. Brown's description.

Supplementary scales attached to Lalanne's abacus enabled the sines and cosines, tangents and cotangents of angles to be read off. Finally, in comparing the operations by means of the abacus with those of the slide rule, it is remarked that the former appears to be more general and comprehensive than the latter, but, on the other hand, it is less exact and practical. To interpolate a line between two inclined

*See "The Uses of Logarithmic Cross-Section Paper," "Engineering News," September 28, 1893.

†"On Graphical Tables and on Anamorphic Geometry Applied to Various Points Connected with Engineering." (Annales des P'ts. et Ch.," 1846, page 1.)

lines, proceed up this to an interpolated vertical line, and then to follow down again, must of necessity prove less exact than mechanically adding the three lengtns together by the slide rule. Doubtless, too, the more convenient and portable form of calculating instrument which the slide rule offers has had much to do with its more extensive adoption.

References to Lalanne's work subsequently appeared in German works on the slide rule, but I cannot trace any application of logarithmic section paper to engineering problems until 1889, when an article by H. Cherry appeared in an English journal,‡ showing the application of the method to problems involved in the adiabatic expansion and compression of air, and also to the pressure necessary to compress textile and other materials in baling presses.

Cherry claims to be the inventor of the method of "graduating the margins of the diagram in a logarithmic scale instead of by equal division." Yet another reinvention of the paper occurred in 1893 by a London civil engineer, E. Human, who patented the "production of sheets ruled with co-ordinates for mathematical purposes in which the co-ordinates are spaced to logarithmic dimensions." (British patent No. 18,237, 1893.)

This appears to end the series of reinventions of logarithmic section paper, and subsequent references to the method consist in extending its application to various complicated problems, some of which it would be interesting to discuss, did time and space permit.

While on the subject of adiabatic curve construction, I may mention that the necessary ordinate values for the curve may be quite readily determined on an ordinary slide rule, by the aid of the radial cursor invented by Mr. F. W. Lancaster, of Birmingham, England. Many cognate problems may be solved by the aid of this useful adjunct to the slide rule. Thus, with the cursor correctly set, one movement of the slide will give such a value as

$$x = 1 - \left(\frac{v_2}{v_1}\right)^{r-1}$$

giving the theoretical efficiency of an Otto gas engine.

M. E.

Manchester, England.

‡"Industries," February 1, 1889.

Schooling for Apprentices.

According to a press report a labor pact which guarantees an education to apprentices has been signed by representatives of the Masons' and Builders' Association and the Bricklayers' Union in Chicago. Under this arrangement apprentices are to be permitted to attend the public schools for three months each year during the first two years of their indenture, and are to attend a technical school for three months during the third year, the wages paid the apprentice to continue during the school period. Never before in a union labor agreement have the employers and the men taken such an advanced step. In the Bricklayers' International Union constitution a reference is made to the right of an apprentice to attend a common school during a short period each year. No opportunity is given, however for the apprentice to get any technical knowledge at school. The paying of the boy by his employer for his time while at school is said to be entirely a new proposition. To insure the highest development of efficiency and ideals the apprentices are hereafter to be under the control of the Joint Board of Arbitration, composed of five members each from the union and the employers' association. The apprentice is to be paid $260 by his employer for the first year, $300 for the second year, and $350 for the third year. In case he does not attain a proper proficiency in his trade in three years he is paid $400 for a fourth year of apprenticeship.

This would indicate that other trades besides that of the machinist are interested in educatonal problems pertaining to their business, and we suppose the agreement entered into is made possible by the fact that building operations especially in the neighborhood of Chicago are at a standstill for a portion of each year, so that apprentices can attend school without loss of time from regular work.

The Veterinarian of To-day.

McJigger—Young Simpkins graduated from the Veterinary College last month, and his father presented him with a case of instruments.

Thingumbob—Surgical instruments, eh?

McJigger—Oh, no. Machinists' tools for repairing automobiles.—"Philadelphia Press."

Personal.

George Krug, late chief machinist U. S. Navy, having served on board the U. S. S. "Pensacola" in her African scientific expedition and on board the U. S. S. "Newark," "Maine," "Texas," and during the late war with Spain on board the dynamite cruiser "Vesuvius," and who has lately been with the Frick Company, engineers, has been appointed as mechanical draftsman and engineer in the Building Bureau of the Board of Education, New York. Mr. Krug passed the civil service examination with a percentage of 95.

Obituary.

John H. Ricketson, president of the A. Garrison Foundry Company, of Pittsburgh, died July 20, sixty-three years old.

H. R. St. John, inventor of the typobar typesetting machine and vice-president and manager of the St. John Typobar Company, died in Cleveland, Ohio, July 27, sixty-six years old.

John Abendroth died at White Plains, N. Y., July 22, seventy-five years old. Mr. Abendroth was born in Germany and came to this country when a young man. In 1845 he, with two brothers, formed the firm of Abendroth Brothers, of Port Chester, N. Y., iron founders, boiler-makers, manufacturers of bolts and nuts, etc., retiring in 1874. He was also for a number of years the senior member of the firm of Abendroth & Root, of this city.

Examination for Physicist.

The United States Civil Service Commission announces that an examination will be held August 21-22, 1900, in any city in the United States where it has a local board of examiners, for the position of physicist in the geological survey at a salary of $1,800 per annum. This examination will comprise English (essay), German, French, laboratory training, mathematics and general physics. Persons who

(*Continued on page 46.*)

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Gear Wheels, gear cutting. Grant; see p. 22.

Dies & punches. Amer. Hdw. Co., Ottawa, Ill.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Forming lathes. Mer.Mach.T.Co., Meriden, Ct.

Punches & dies. Wal.M.Wks., Waltham, Mass.

Wanted to Rent—A small, well-equipped machine shop. Address T. C., AMER. MACH.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Book "Dies and Diemaking," $1, post paid. J.L.Lucas, Bridgeport, Ct. Send for index sheet.

F. J. Stokes Machine Co., 13th and Noble sts., Philadelphia, Pa., build light machinery.

"Brandt's Triple Expansion Gaskets" are the best for boilers. Randolph Brandt, 38 Cortlandt st., New York.

Wanted—Parties with facilities to manufacture medium and heavy high-grade machinery. Address "Phila.," care AM. MACH.

Choice Factory Site.—In Jersey City, N. J., 2 acres, close by switch, C. R. R. N. J.; on trolley route; near M. & E. Canal. Address "B.," AMERICAN MACHINIST.

Good, practical machinist wanted to run machine shop of his own in central part of Wisconsin; must have $3,000 capital; good business and location. Box 175, AM. MACH.

Gear and Milling cutters, adjustable reamers and special tools; vertical millers, cutter and surface grinder and shears. Catalog of small tools free. R. M. Clough, Tolland, Conn.

Wanted—Staple articles to manufacture requiring light machine work; brazing, hardening, plating and enameling facilities, with brass foundry and wood shop connected. Address Box 197, AMERICAN MACHINIST.

Institutions retiring from business having machine tools, brass and wood working machinery will find it to their interest to correspond with us. We purchase complete plants or handle them on com. C. C. Wormer Mach. Co., 55-59 Woodbridge st., W., Detroit, Mich.

A well-equipped machine shop and foundry, with ample water power, capacity 50 mechanics, tools suitable for engine building up to 24 x 24-inch or similar work, invites proposals in their line, or will consider manufacturing new specialties. Address P. O. Drawer 414, Lockport, N. Y.

An Opportunity.—Established concern, 10 years' standing, having modern machine-shop equipment, etc., a year-in-and-year-out trade on a distinctive line light machine tools, desires to retire from manufacturing but hold its good-will and sale of its products; would rent its establishment as it stands (in Philadelphia), or it may be removed, and would furnish at least $25,000 worth profitable business. Address Box 199, AMER. MACHINIST.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach

(*Continued on page 46.*)

desire to compete should at once apply to the United States Civil Service Commission, Washington, D. C., for application forms 304 and 375, which should be properly executed and promptly filed with the Commission.

New Catalogs.

The Soule Steam Feed Works, Meridian, Miss., have sent us their sawmill machinery catalog. They make steam sawmill feeds, edge lumber stackers, power loaders and unloaders, dogs and other special machinery. Size, 5x8 inches.

Hardinge Brothers, 1036 Lincoln avenue, Chicago, Ill., send a catalog showing a great variety of chucks and other tools and supplies adapted to watchmaking and kindred purposes. Some of them are newly added to the list. Size, 6x7 inches.

The Hamilton Machine Tool Company, Hamilton, O., has sent us a new catalog describing and displaying its regular line of engine lathes, upright drill presses and radial drills. Separate notice is given to some lathe attachments, including turrets, rests and toolholders. It is a business-like pamphlet, printed on heavy paper and illustrated with half-tones. Size, standard, 6x9 inches.

Manufacturers.

John B. Ray will put a big cotton ginning outfit at Bynum, near Oxford, Ala.

A movement is on foot to establish the Jackson typewriter factory in Lyons, N. Y.

The Baltimore & Ohio Railroad has decided to build a 500,000-bushel elevator at South Chicago.

The Mt. Wolf Manufacturing Company, York, Pa., will build an addition to its factory the coming fall.

An addition is to be built to the Tioga foundry, Twenty-second street and Allegheny avenue, Philadelphia.

It is reported from Colorado Springs, Colo., that the Portland Company will soon build a smelter to treat its own ore.

An addition to cost $500,000 will be erected at the Ohio works, in Youngstown, of the National Steel Company, New York.

Lutz & Schramm Company, picklers and preservers, of Allegheny, Pa., will fit up with improved machinery a plant newly acquired by them.

H. D. Hale & Co., Columbus, O., have broken ground for a small brick factory building on Merritt street, between Parsons avenue and Ninth street.

An addition is being built at the silk mill of the Klotz Silk Throwing Company, between Poplar and Walnut streets, Green Ridge, Scranton, Pa.

Pennsylvania and New York capitalists are planning to develop iron properties in Skagit County, Wash., and to spend $200,000 for a suitable plant.

It is announced from Detroit, Mich., that the St. Johns Spring Works will remove its plant to Pontiac, Mich., where it will erect an extensive plant.

The Moore & White Company, Philadelphia. manufacturer of paper mill machinery, has had plans filed for a three-story factory building, 88x242 feet.

The General Manifold Company has just received, at its office in the city of Franklin, Pa., bids for the erection of a brick and steel structure, 400x150 feet.

(*Continued on page 47.*)

Wants—Continued.

us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents.

Situations Wanted.

Draftsman and machinist seeks position; general machinery. Box 195, AMER. MACH.

Head draftsman's position, by technical graduate; references. Box 209, AM. MACH.

A successful machine-shop foreman is open for engagement. Box 196, AMER. MACHINIST.

Experienced draftsman, age 22, desires chance to become specialist. Box 202, AM. M.

Foreman patternmaker, young man with good experience, desires position. Box 201, AMERICAN MACHINIST.

Draftsman, experienced on intricate machinery; technical graduate; best references. Box 210, AMERICAN MACHINIST.

First-class draftsman and designer, considerable experience, desires position immediately. Address Box 215, AMER. MACHINIST.

Wanted—Position as foreman or outside hand erecting; 6 years on the road erecting Corliss engines, pumps and complete plants; age 35. Box 207, AMERICAN MACHINIST.

Position as foreman, by thorough steam-pump man; quickest methods of producing and duplicating; good manager of men; references. Address Box 212, AMER. MACHINIST.

Wanted—Situation as foreman patternmaker, by one having 18 years' experience at pattern making; 8 years as foreman; can handle men successfully. Box 203, AM. M.

Position in shipbuilding office wanted by marine engineer; experienced in designing, principally ships, but also marine engines; technical graduate. Address Box 198, AM. M.

Experienced draftsman, heavy power-transmission work, cotton machinery layouts, modern mill design, automatic machinery; technical education; references. Box 214, A. MACH.

Twenty years' experience (12 as draftsman, foreman and superintendent) has fitted the applicant to superintend your shop if you manufacture light interchangeable metal work by modern methods. Address Box 192, A. M.

Superintendent of large machine plant, with good judgment and very wide experience; plenty of force and executive ability to keep things moving; parties needing a superintendent and not a novice, please address Box 200, AMERICAN MACHINIST.

Situation wanted by general superintendent; can handle all kinds of work, engine, electric light and mill work; can furnish reference; at present general superintendent in works employing 400 men; wish to make a change. Address D. A. J., care AM. MACH.

Help Wanted.

Wanted—Machinists familiar with high-grade engine work. Address Box 208, AM. M.

Machinists wanted; good wages and steady work. Apply De La Vergne Ref'g Machine Co., foot E. 138th st., New York.

Draftsmen desiring extra money, state where employed, confidential. Edwin Guthrie, Corcoran Building, Washington, D. C.

Wanted—First-class toolmaker, capable of managing help for new automobile shop; wages $25. Box 204, AMERICAN MACHINIST.

Foundry foreman in central New York; gray iron medium and small castings; 20 molders; 5-ton heats. Address Box 181, A. M.

Wanted—Four good machinists, experienced with heavy work; steady employment. Wheeler C. & E. Co., Carteret, N. J. (15 miles from New York City).

Machinist contractor wanted to handle about 75 men; one acquainted with steam, oil and gas engines preferred. T. M. D., AMERICAN MACHINIST.

Wanted—General foreman for erecting shop near Chicago; good salary to capable man; both heavy and light work. Address Box 206, AMERICAN MACHINIST.

Foundry foreman; one who can take charge of 150 men and produce results; state experience, salary wanted and age. Address "Ohio," care AMERICAN MACHINIST.

Draftsman.—Wanted—Efficient draftsman from New York City; one familiar with sugar machinery preferred. Address, with full particulars, A. G., AMERICAN MACHINIST.

Expert layer-out for boiler shop; one accustomed to laying out intricate work from blueprints. Address, giving age, experience and salary expected, L. O., care AM. MACH.

Wanted—Experienced draftsman on mining and quarrying machinery; must be rapid and accurate. Apply, stating experience and salary expected, Box 205, AMERICAN MACHINIST.

Wanted—An instructor in mechanical engineering; shop and drawing-room experience, also diploma from technical school, required. Address, stating qualifications, age, etc., Box 153, AMERICAN MACHINIST.

Wanted, Immediately—12 first-class toolmakers; none but those accustomed to fine work need apply; also 12 first-class, all-around machinists. Address Driggs-Seabury Gun & Ammunition Co., Derby, Conn.

Almond Drill Chuck.

Sold at all Machinists' Supply Stores.

T. R. Almond,

83 & 85 Washington St., Brooklyn, N Y.

GAS or GASOLINE ENGINE.

2 1-2 H. P.

Nearly New with Latest Improvements.

PRICE, - $65.00.

Address **J. H. S., Home Engraving School,**

BOX 1171, SPRINGFIELD, MASS.

WANTED

First-Class Machine Shop and Foundry

to build under contract a line of machines (similar to first-class engine work) that have been on the market for ten years and are known and used all over the world in highest class power plants. Fifty machines sold yearly at cost of $50,000. Weights run from 1,000 to 50,000 pounds each, for standard sizes. Special sizes up to 200 000 pounds.

Present facilities entirely inadequate and business growing fast. Shop convenient to New York preferred.

Address, stating facilities,

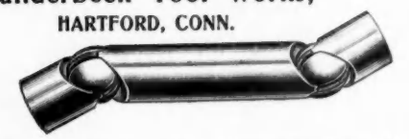
"SHOP," care American Machinist.

From ¾ in. to 3 in. Diam.

Universal Joints.

Vanderbeek Tool Works,

HARTFORD, CONN.



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faster and better than you mill cast-iron ones. You wouldn't ask the reason after seeing the chips. They roll up like chips from a lathe tool. We don't scrape them off, but cut them off. Cutter has a top rake you know. Let us tell you more about it.

The Fellows Gear Shaper Co.

SPRINGFIELD, VT.